

realize, however, that research on the effects of atomic weapons was just beginning. Consequently, on 21 April 1948, the RADLAB was formalized as the NRDL with a greatly expanded mission (HRA-587 p 3). The new responsibilities included practical and applied research into the effects of radiation on living organisms and on natural and synthetic materials, in addition to continued decontamination experimentation.

From an initial RSS staff of three in 1946, the NRDL personnel roster grew to 177 in January 1949 and to 200 by March 1949 (HRA-10). NRDL's first dedicated building was Building 506, the former shipyard dispensary. But it soon became evident that this building was too small, and NRDL expanded into Buildings 507 and 510 in 1948 and Building 351 and additional Quonsæt buildings in 1949 (HRA-587, p 19; HRA-1500, p 1; HRA-1752, p 3; HRA-1797 Encl A, pp 1-2).

6.3.1 1950-1969

By 23 January 1950, NRDL occupied ten buildings at HPS: Buildings 224, 313, 313A, 322, 351, 506, 507, 508, 510, and 701 (HRA-20, pp 3-4). Research requirements were rapidly increasing, creating demand for additional space and personnel. With their functions growing disparate, NRDL was made a separate command from HPS on 1 October 1950 (HRA-587, p 3). However, NRDL still reported through the Commanding Officer of HPS. Again, the laboratory mission was expanded to beyond the basic and applied research in radiation effects on materials, vessels, and personnel to include further development of defensive measures for ships, personnel, and shore installations (HRA-587, pp 3-4).



Ex-INDEPENDENCE Prior to Being Sunk in January 1951
(San Francisco Maritime National Historical Park,
National Park Service)

Since its return from OPERATION CROSSROADS, the carrier ex-INDEPENDENCE was retained for use by the RADLAB and subsequently by NRDL for experimentation, testing of decontamination methods, storage of radioactive wastes, and as a dockside laboratory (HRA-361, p 1; HRA-1639, p 2; HRA-1702; HRA-1708). In 1950, ex-INDEPENDENCE was docked at Berths 16 and 17 at the Regunning Pier (Gun Mole), where NRDL had a field laboratory that managed work on the carrier. This field laboratory eventually included a converted barge (YFNX-16), a decontamination pad, and personnel clothing change and decontamination facilities (HRA-253; HRA-396). Ex-INDEPENDENCE, loaded with radioactive waste from NRDL and other generators, was towed to sea and sunk in January 1951 (HRA-1424; HRA-1739; HRA-1910; HRA-1925; HRA-2721).

NRDL's barge and decontamination facilities remained on the Gun Mole until at least 31 December 1958. No specific records have been located concerning turnover of this area of the Gun Mole to the shipyard. However, there is evidence that, following the removal of the barge and decontamination pad, the Gun Mole was graded and resurfaced (HRA-1106).

The health and safety of workers involved in work with radioactive materials were primary considerations of both the Navy in general and NRDL in particular. Throughout decontamination experiments and research activities, exposures were monitored and limits adjusted as the laboratory gained more knowledge and effects of exposure to radiation became better understood. BUSHIPS and BUMED implemented regulations and procedures throughout the Navy based on work done and knowledge gained at NRDL. While NRDL existed as a Navy facility, it also had units from the other military services attached to it. The same regulations and procedures developed for the Navy by NRDL often became common across the DoD (HRA-587, pp 14-15).

Throughout the 1950s, NRDL was a unique and important entity recognized as a leading research facility in the country for study of nuclear safety (HRA-2467). NRDL continued experimentation on the biological effects of exposure to radiation, decontamination technologies, radiation protection measures, nuclear warfare defensive measures, and fire protection. Many organizations, including the California Department of Public Health, California Highway Patrol, Office of Civil Defense, U.S. Public Health Service, and the AEC used the expertise of the

laboratory and its personnel to develop regulations and controls governing the growing use of radioactive materials in the public sector (HRA-1160).

As NRDL grew, so did its level of responsibility. In September 1955, NRDL was made a separate command with its own Officer in Charge. NRDL no longer reported through the Shipyard Commander but instead reported directly to BUMED and BUSHIPS (HRA-423).

On-site technical support and research during nuclear weapons testing at the Nevada Test Site and Pacific Proving Grounds (Marshall Islands) comprised a large portion of the work done at NRDL during the time of atmospheric nuclear weapons tests. Laboratory personnel participated in every nuclear weapon test between 1950 and 1958 (HRA-587, p 32). Personnel and equipment would be dispatched from the laboratory to the test sites to provide test support, such as overall radiation safety, collecting and processing of samples, personnel dosimetry, monitoring workers and equipment for radioactive contamination, and animal exposure experiments.

Two ex-Liberty ships, YAG-39 (ex-GEORGE EASTMAN) (HRA-1215) and YAG-40 (ex-GRANVILLE S. HALL) (HRA-1218), were specifically modified through the period 1952 to 1955 to support and study the effects of atomic and nuclear weapons (HRA-449; HRA-451; HRA-998). The two ships had a long history of use associated with NRDL and the Navy. The primary mission for them while assigned to NRDL was on-scene support and research during weapons tests in the Pacific. As was experienced with OPERATION CROSSROADS ships, the YAGs became radioactively contaminated when they were used at weapons tests (HRA-461). They returned to HPS for decontamination, modification, repair, and storage when they were not in use. Documents indicate that decontamination operations were calculated with controls defined and imposed. A concentration limit for liquids of 1×10^{-5} $\mu\text{Ci/cc}$ “specific activity” (no definition of radionuclides) was imposed. Sandblast material was to be controlled (collected and drummed as radioactive waste) during removal of “hot spots” (not further defined). Once the hot spots were removed, the remaining sand could be disposed of in the Bay (HRA-202; HRA-259). By 1956, a new directive regarding the disposal of liquids and sandblast material into the Bay stated that decontamination was to be “*witnessed by shipyard personnel to prevent runoff of contaminated liquids or dumping of contaminated wastes into bay waters at dockside. All*

contaminated wastes shall be disposed of in accordance with existing regulations” (HRA-165, p 2; HRA-461, p 5).

The YAGs were used for the basic mission of research and weapons test support through the late 1960s (HRA-1527). YAG-40 was sold commercially in 1972, and YAG-39 was stricken from active service in 1975 (HRA-1216; HRA-1237).

Other ships returned to HPS for decontamination following participation in weapons testing. An example would be the USS KILLEN, a target ship that returned to HPS following participation in OPERATION HARDTACK I. No specific records were located documenting the number of ships nor their locations while at HPS. However, it is assumed that the same decontamination standards and practices were employed as those used for the YAG-39 and 40.

6.3.2 Radionuclide Use and Control

Because of the breadth of the research performed, NRDL used a large number of radionuclides. Prior to 1954, use of radionuclides was controlled, but not licensed, by the AEC. The RADLAB/NRDL established a working relationship with the AEC early in its existence and complied with the provisions of the AEA (HRA-1284). The laboratory was required to acquire and control radionuclides through the AEC.

With the implementation of the AEC Licensing Program in 1954, the use of radioactive materials at the laboratory and at off-site test facilities operated by the laboratory was controlled by licenses issued by the AEC. The use of radium was an exception to the licensing requirement because radium was not regulated by the AEC but was controlled by the Navy. A complete listing of radionuclides used by the laboratory is included in Table 4-2. Table 5-1 details the specific licenses and the radionuclides authorized by those licenses.

NRDL was a pioneer in the development and use of radiation sources. The laboratory needed known radioactive sources to calibrate RADIACs and dosimetry devices such as film badges and pocket dosimeters. They used various sources for animal studies to simulate fallout and other tests and experiments. Sources were purchased from AEC-qualified vendors or created

at a university or government laboratory engaged in such activities and authorized by the AEC (HRA-1349; HRA-1353).

NRDL created individual sources from bulk quantities of isotopes. They would typically purchase the radioactive material from a vendor or another laboratory and would divide the material at NRDL for use there or for shipment to another, usually Navy, facility (HRA-246; HRA-395). Most of these sources were short half-lived (less than 3 year half-life), but some had relatively long half-lives (for example, Ra-226, 1,599 years). Because these source materials were not sealed and were manipulated in the laboratory, they were subject to occasional spills. The Health Physics group maintained tight controls over these radioactive materials. Spills were decontaminated and material accountability maintained (HRA-562, pp 2-6; HRA-565, pp 2, 15).

Sealed sources, purchased from AEC-qualified vendors, were relatively easy to control. These sources were routinely tested to detect leakage. If leakage was found, the source was returned to the vendor for repair or replacement, or disposed of as radioactive waste. When NRDL closed in 1969, remaining sealed sources either were returned to the vendor, sent to another Navy facility licensed for receipt, or disposed of as radioactive waste at an off-site, licensed disposal facility (HRA-138; HRA-1044; HRA-1047; HRA-2772, p 19).

In addition to AEC license controls, NRDL established an AEC-mandated Radioisotope Committee (RIC) to manage the use of radioactive materials and machines that produced ionizing radiation at the laboratory. The committee, comprising senior members of the laboratory staff, had responsibility for enforcing safety directives, developing procedures and policies for NRDL, investigating spills of radioactive materials and personnel overexposures, and implementing corrective measures (HRA-587, p 11).

NRDL also had a Health Physics Division to implement the requirements of the RIC by managing the Radiological Control Program, maintaining records, and providing investigative resources (HRA-587, p 10). The Health Physics Division evaluated requests for experimental use of radioactive materials prior to submittal to the RIC for approval.

From the beginning, NRDL occupied many buildings at the shipyard. In March 1955, most of the NRDL's 600 staff members moved to Building 815, which had been specifically

designed and constructed for NRDL (HRA-587, 19-21; HRA-1327, p 5). After moving from buildings it formerly occupied, NRDL personnel surveyed them for residual radioactive materials. Surveys were done in Buildings 142, 224, 313, 313A, 322, 351, 351A, 366 (formerly known as 351B), 507, 508, 510, and 520. NRDL reviewed survey results and cleared these buildings prior to returning them to the shipyard once they met the release requirements of the period (HRA-409; HRA-274; HRA-674; HRA-975; HRA-1073; HRA-1074). The HPS buildings used by NRDL are listed in Tables 6-5A (through 1955) and 6-5B (after 1955).

In some cases, for example Building 506, restrictions were placed on future activities, such as drain line removal and replacement, indicating there was concern that not all radioactive materials were recovered or removed (HRA-275).

Building 815 was designed with laboratory operations defining the parameters for construction. Ventilation systems were filtered to preclude releases of airborne radioactive contaminants from the building to the environment. Source storage facilities were provided in the basement. Two 15,000-gallon underground liquid effluent holding tanks were located outside the building. Discharges of potentially radioactive liquid were captured in these tanks and tested to ensure they met contemporary release limits prior to discharge. Radioactive sources and samples used by individual laboratories were placed in heavily shielded and locked rooms within the building known as “caves” (HRA-599).

Additional support facilities were constructed in the period following the move to Building 815. Building 816 was built to house the Van de Graaff generator (HRA-2113). Buildings 830 and 831 were built to provide an environment to house a pathogen-free small animal colony (HRA-557, p after p 10). A Co-60 irradiator was also installed and used in the hot cell in Building 364 for animal experimentation (HRA-48, p 8).

The consolidation of activities in Building 815 did not include all activities of NRDL. Buildings 364, 365, 506, 529, 707, 816, 820, 821, 830, 831, and ICW 418 were also used by NRDL until it closed in 1969 (HRA-1517, p 2).

6.3.3 Other Radiation Generators

In addition to the use of radioactive isotopes, NRDL owned several machines that used electrical energy to generate radiation and charged particles. The following devices are known to have existed at NRDL:

- X-ray machines in Building 815
- Low-power neutron generator in Building 506
- A 600-kilovolt (kV) Kevatron particle accelerator in Building 510A
- A Van de Graaff particle accelerator in Building 816
- A Cyclotron particle accelerator in Building 820

These machines produced ionizing radiation (x-ray machines), low-energy (Kevatron), or high-energy particles (Van de Graaff and Cyclotron) only when they were energized. NRDL used these devices to calibrate instruments and to irradiate animals and materials. Details of the locations for these devices are in Section 8.0. Except for the Cyclotron, they were all fully functional during the period NRDL existed. The Cyclotron was constructed during the last few years of NRDL's existence (HRA-47, p 1; HRA-50, p 1). It was only in the testing phase when NRDL was disestablished. It never generated a particle beam external to the machine nor did it ever operate at its full rated power (HRA-1596).

Because these machines did not contain radioactive materials, they could not have impacted the buildings in which they were located by direct contamination. However, radioactive materials were used as targets for the particle generators, particularly the Van de Graaff and Kevatron generator. The primary isotope used as a target was H-3. There had been concerns about H-3 contamination at and around Building 816 where the Van de Graaff had been located. Surveys of this area were done in 1970 and 1993 (HRA-2772, pp 9-10; HRA-576). The 1993 survey is discussed in Section 6.4.

6.3.4 Waste Disposal Operations

From the late 1940s through 1959, NRDL and HPS conducted radioactive waste disposal operations. NRDL accepted and consolidated waste from other military installations, as well as educational institutions, research laboratories, and the AEC, and packaged the wastes for

disposal. NRDL then worked with HPS to load the containers onto barges and to ship the material to an ocean disposal site near the Farallon Islands. NRDL was the primary military agency disposing of waste at the Farallon Islands. Commercial agencies also disposed of waste there during this time period (HRA-1156; HRA-1159; HRA-1238; HRA-1241; HRA-1278).

In general, the generator notified NRDL that they had waste for disposal. Funding documents and cost estimates were created. The waste materials that were shipped into HPS, were received and stored at the Building 707 waste storage area, also known as the “707 Triangle” because it was the triangle-shaped property bordered by “J” Street, “R” Street, and 6th Avenue. The waste packages primarily consisted of 55-gallon drums. However, concrete casks were also designed and used for disposal of larger items. Numerous types and forms of radionuclides and various experimental media were included in the waste. Carcasses of small animals used in research were packaged in drums; large ones were either packaged in larger containers or cut up and put into drums. Concrete was added to the waste to weight the drums. Once at the disposal location, the containers were off-loaded and sunk. Should a drum not sink, it was fired upon with rifles until it sank. If it could not be sunk, it was recovered and returned to HPS. Waste processing, packaging, and disposal activities were detailed in NRDL procedures (HRA-590).

Complete historical records documenting the exact inventories of waste disposed of or the number of containers shipped from HPS was not found. However, several NRDL annual reports do provide some details (HRA-561, p 29; HRA-562, p 11; HRA-563, pp 18-20; HRA-564, p 25; HRA-565, p 22). An NRDL letter of 1958 summarized a total of 1,780 tons of DoD waste dumped at sea from 1954 to August 1958 (HRA-1350). An EPA report of 1980 estimates that 47,500 containers, mainly 55-gallon drums containing 13,500 curies of radioactive waste, primarily short-lived radioisotopes, were disposed of at the Farallon Islands from 1946 to 1970. The report includes waste from both NRDL and commercial shippers (HRA-1243).

Waste disposal was conducted under AEC authorization. However, it was not formally licensed until 1959 shortly before NRDL stopped accepting waste from other entities and waste disposal operations were contracted to a commercial vendor (HRA-1080; HRA-1085; HRA-1086; HRA-1087; HRA-1129; HRA-1333).

By 1958, commercial options for disposal of radioactive waste materials were being evaluated and recommended by NRDL. Contracts between NRDL and other generators for waste disposal were cancelled or not renewed with recommendations to contract with commercial sources for the service (HRA-1085; HRA-1086; HRA-1087). For a period of time, disposal was administratively assigned to the Military Sea Transport Service (MSTS); however, MSTS failed to obtain a license for disposal activities, and the operation again fell to NRDL with the assistance of HPS for a short period of time during late 1959 and early 1960 (HRA-213; HRA-1086; HRA-1113).

A 1961 procedure for disposal of radioactive wastes demonstrates an organized and detailed methodology for handling, storing, packaging, and disposing of wastes. It also states that ultimate disposal was to be done by a commercial vendor. Solid waste was to be processed and packaged at the waste handling area near Building 707. All radioactive liquid waste was collected from the various laboratories and processed in a liquid radioactive waste holding tank outside Building 364. Once the tank was full, acidic or basic waste was neutralized, if necessary, and disposed of through a commercial company that pumped the waste from the tank and removed it from HPS for further processing and disposal at an off-site licensed disposal facility (HRA-590).

In addition to off-site waste disposal, small amounts of low-level radioactive liquids were authorized for release via the site drainage or sanitary sewer systems. Because it was permitted by regulations of the time, it is reasonable to assume that NRDL disposed of small amounts of low-level liquid effluents through the building drains. These releases would have included dilution to ensure that they met the AEC release limits (HRA-1705).

6.3.5 Fallout Studies

One of the most significant areas of research at NRDL was the ongoing study of fallout. Fallout refers to the radioactive debris from an atomic or nuclear event such as the explosion of an atomic or nuclear (hydrogen) bomb. This radioactive debris is generally in three forms:

- The weapon's fission products or radioactive isotopes of the smaller elements produced when a large uranium or plutonium atom is split by neutrons freed in the chain reaction that creates the bomb's explosive force
- Excess neutrons that are not consumed in sustaining the chain reaction but react with the materials in the air, ground, and water where the bomb is detonated to make them radioactive
- Uranium or plutonium from the bomb's core that was not consumed in the fission process

When a bomb detonates, it creates intense heat, wind, and a debris cloud. If the blast is underwater (as in Shot Baker), there is also a wall of highly contaminated water pushed out from the blast. This wall of water is called a base surge.

As the cloud (and base surge for an underwater explosion) expands away from the blast, the radioactive particles begin to cool and fall back to earth. This is why the material is called fallout. Larger particles fall close to the site of the detonation. Small particles are carried by the wind for distances based on their size. Some of them are so small that they spread far from the source. Thus, fallout from the explosion of a weapon (or a catastrophic accident like Chernobyl) can travel thousands of miles from its source.

Most of the radioactive isotopes in fallout have short half-lives; however, some of them are longer lived. Plutonium-239 (Pu-239), for example, has a half-life of 24,000 years. Cs-137 (30-year half-life) is the easiest fallout radionuclide to detect today due to its predominance and relative insolubility in water. The long-lived isotopes are the ones that can be detected years after a nuclear event. These are the isotopes that remain a concern at HPS.

NRDL collected large quantities of fallout material at most U.S. atmospheric weapons tests. Sample collection ranged from small air sampler filters to large trays with thick layers of collected material. These samples were both counted in the field and returned to NRDL for further analyses. Based on the results of these analyses, the explosive yield of the weapon (measured in kilo- and megatons equivalent to TNT) could be determined.

NRDL scientists would process fallout samples to reduce them to a form that would suit the counting geometry. For example, samples would be dissolved in strong acid, neutralized,

and dried before counting. Most sample preparation was done in filtered laboratory hoods. Large quantities of fallout material were collected and prepared by NRDL. Therefore, areas where it was handled are considered impacted.

Several interviewees remembered that after fallout samples were processed the remainder of the material was saved. Saved samples were stored in various shielded containers and rooms in NRDL facilities. When there was no further need for them, they were disposed of off site as radioactive waste. At NRDL's closure in 1969, samples that remained in storage were disposed of as radioactive waste under the disposal criteria in place at that time (HRA-1100). Known sample storage locations are included in the impacted sites.

6.3.6 Animal Studies

Beginning with OPERATION CROSSROADS, various animals were used for research during the detonations. The use of animals as substitutes for human beings exposed to hazardous materials and environments is not unusual. To the planners of OPERATION CROSSROADS, they were a natural choice for the study of both radiological and physical bomb-induced effects (HRA-578, p 68).

From the beginning, the RSS, RADLAB, and NRDL used animals for experimentation. There were animal facilities at HPS and at Camp Parks, near Dublin, California. Typically, smaller animals were raised and kept at the shipyard and larger animals at Camp Parks. Over the years bees, moths, bats, mice, rats, cats, monkeys, mules, hamsters, guinea pigs, dogs, pigs, sheep, goats, burros, and cows were kept and used as subjects for a wide variety of research involving radioactivity and radioactive materials. Animal experimentation continued up to the disestablishment of NRDL in 1969.

At HPS, animals were raised and kept in animal pens near Building 704 and in Buildings 365, 506, 507, 517, 707, 708, 815, 830, and 831. NRDL purchased animals from vendors but also had breeding colonies to raise pathogen-free animals, especially in Buildings 815 and 830 (HRA-51, pp 9-10).

Animals were irradiated by use of the laboratory's x-ray machines. They also were exposed to high levels of radioactivity in sealed-source irradiators and injected with radioactive materials. Some were exposed to radionuclides to study the physiological changes induced by the radioactivity. Other experimental work involved extensive studies of liver function. Research animals were studied, sacrificed, and autopsied.

Carcasses of animals that were not radioactively contaminated were disposed of as waste, usually through a vendor who specialized in animal disposal, although there is evidence they were also discarded in the on-site landfill. An incinerator was constructed for use by NRDL for disposal of animal remains and wastes (HRA-172, p 6).

The carcasses that had been dosed with radioactive material were considered radioactive waste and their disposal was carefully controlled. In the early days, they were drummed and buried at sea with other radioactive waste. When sea disposal was no longer an option, the radioactive carcasses were disposed of at a licensed off-site disposal facility with other radioactive waste (HRA-590, p 5).

6.4 HISTORICAL RADIOLOGICAL INVESTIGATIONS, SURVEYS, AND STUDIES

Since the beginning of radiological operations at HPS in 1946, radiological investigations and removal actions have been conducted by various groups and regulatory agencies to assess and remove residual G-RAM resulting from these operations. NRDL, Navy contractors, regulatory agencies, and RASO have conducted various radiological surveys and studies to evaluate residual radioactive contamination and risks from radiological operations at HPS through the years. These investigations and surveys include:

- 1946 through 1948 RSS and NRDL surveys and decontamination of OPERATION CROSSROADS ships and drydocks
- 1955 NRDL surveys to decommission NRDL buildings at HPS
- 1969 NRDL survey for disestablishment of NRDL
- 1969 to 1970 AEC survey to verify NRDL's survey results and release buildings for reuse
- 1974 HPS survey for base closure

- April 1978 LFE Environmental Analysis Laboratories, Inc. (LFE), survey of Building 815
- July 1978 RASO survey of Building 815 to confirm LFE survey findings
- September 1978 RASO survey of former NRDL buildings
- 1979 RASO resurvey of Buildings 364, 815, and 816
- 1986 EPA harbor survey at NNPP request
- 1988 to 1989 Harding Lawson Associates (HLA) site reconnaissance
- 1991 to 2001 surveys conducted for the RI program in four phases: Phases I through IV, including the following interim investigations:
 - 1997 Parcel E radiation risk assessment
 - 1999 to 2001 interim investigations between the Phase IV and Phase V investigations
 - 2001 to 2003 Phase V investigations and removal actions

6.4.1 1946 through 1948 OPERATION CROSSROADS Surveys

OPERATION CROSSROADS ships were decontaminated from 1946 to 1948 at Drydocks 3, 4, and 6 and various berthing spaces. BUMED, BUSHIPS, and RSS personnel coordinated the decontamination, monitoring, and clearance of ships exposed during OPERATION CROSSROADS tests. After each ship was decontaminated, Navy personnel performed a radiological survey and decontamination of the drydock (HRA-454; HRA-471; HRA-506).

The most effective decontamination method was sandblasting the contaminated surfaces of a vessel. In general, spent sandblast wastes containing “all rust and marine growth” were containerized and disposed of by ocean disposal. Other spent sandblast materials and decontamination solutions were authorized for disposal to the Bay (HRA-454; HRA-471). During 1946 and 1947, radioactive wastes from these activities were disposed of in an approved zone at least 10 miles at sea, or beyond the 100-fathom curve (contour line indicating an ocean depth of 600 feet). After removal of the sand, the drydock floor was washed down vigorously and the water pumped into the harbor. Surveys of the drydocks were performed after undocking of the ship (HRA-454; HRA-471; HRA-506).

Documents from 1947 indicate that Drydocks 3, 4, and 6 were at background levels when surveyed by Navy personnel, except for two anomalies found at Drydock 4. However, they met the cleanup criteria for release using radiation detection instruments available at the time (HRA-206; HRA-509).

6.4.2 1955 NRDL Surveys

In March 1955, NRDL consolidated most of its facilities into Building 815 and surveyed the buildings it formerly used for free release to the shipyard's use and control. Surveys were conducted in Buildings 313, 313A, 322, 351, 351A, 366 (formerly known as 351B), 506, 507, 508, and 510. The NRDL release letters confirm that these buildings were surveyed and released for unrestricted use in 1955 during the transfer of operations to Building 815 (HRA-223; HRA-224; HRA-225; HRA-227; HRA-275; HRA-304; HRA-305; HRA-674; HRA-1073; HRA-1074; HRA-105). Buildings 506 and 351A were released with the following caveats regarding the pipes and the sanitary sewer system (HRA-275; HRA-305):

- A radiation monitor must accompany working parties on the sewer systems for on-the-job monitoring until the present drain lines are replaced.
- Drain lines removed from Building 351A in the future must be disposed of as low-level radioactive waste so they will not be reused.

No site-specific survey or decontamination procedure was found for the 1955 NRDL surveys. However, under existing AEC guidelines, all NRDL buildings were required to be thoroughly surveyed and decontaminated prior to abandonment or release for unrestricted use. For final clearance, former NRDL facilities were required to meet the residual contamination levels established by BUMED for decontamination of Navy facilities and equipment. The release limits as stated in the memo are:

*“Gamma contact dose rate less than 1.8 mR/hr
Beta dose rate less than 9 mrep/hr
Fixed beta-gamma contamination less than 10,000 d/m/cm²
Removable beta-gamma contamination less than 4,000 d/m/cm² by a wipe test
Fixed alpha contamination less than 500 d/m/cm²
Removable alpha contamination less than 1 d/m/cm²” (HRA-304).*

Note: Terms in the above are defined as:
mR/hr – millirem per hour
mrep/hr – milliroentgen equivalent physical per hour
 $d/m/cm^2$ – disintegration per minute per square centimeter

6.4.3 1969 NRDL Survey for Disestablishment

On 25 April 1969, Navy's Chief of Naval Material issued a letter announcing that NRDL would be closed ("disestablished" in Navy terms) by December 1969 (HRA-1597). All radiological operations were suspended. Surveys were performed in areas where G-RAM-related operations were conducted to ensure applicable radiological release criteria were met.

Termination of the AEC licenses required the transfer of all G-RAM sources to other licensed operations or disposal at a licensed off-site disposal facility. In addition, all areas involving G-RAM-related operations occupied by NRDL required decontamination, if necessary, to reduce radioactivity to acceptable levels for unrestricted use. The NRDL Health Physics Division surveyed and decontaminated Buildings 364, 506, 529, 707, 815, and 816 (HRA-1479).

The surveys consisted of measuring alpha and beta-gamma radiation levels and collecting swipe samples to detect removable contamination. Any NRDL areas found to be radioactively contaminated were further decontaminated. In general, decontamination was accomplished by:

- Removal of all radioactive source material
- Measurement of external radiation levels
- Swipe sampling of all areas involving G-RAM-related activities
- Decontamination by washing or scrubbing with detergents, dilute complexing agents, mild acids, or combinations of the above
- Chipping, sandblasting, vacuuming, and high-pressure steam cleaning
- Dismantling of radioactive equipment that could not be readily decontaminated using the procedures discussed above and disposal at a licensed radioactive waste disposal facility

The AEC Division of Compliance conducted a final inspection of all areas monitored and decontaminated by NRDL (HRA-1479, pp 19-20).

A localized contaminated area was considered decontaminated by the AEC when the gamma dose rate at 1 centimeter above the surface averaged less than 0.2 millirem per hour (mrem/hr) and the removable activity per 100 square centimeters of surface area was less than 1,000 disintegrations per minute (dpm) beta-gamma. For alpha contamination, a localized contaminated area was considered decontaminated when the fixed activity was less than 500 dpm per 100 square centimeters (500 dpm/100 cm²) and the removable activity was less than 100 dpm (HRA-1479, p 4).

Decontamination and removal actions conducted at each former NRDL building are summarized below.

- **Building 364** – Radioactive liquids in the two holding tanks in the yard area were pumped into a tank truck and removed by a commercial contractor. The tanks were then removed from the pit and disposed of as radioactive waste. The pit was decontaminated by chipping the surface concrete until radiation levels and swipe sample analyses were below AEC-mandated levels. The pump shed and all associated plumbing, as well as all plumbing from Building 364 to the tank pit, were removed except for one pipe leading to a concrete slab. AEC recommended leaving that pipe in place and filling the pipe excavation with concrete. The walls of Room 108 were washed with detergent (HRA-1479, pp 15-16).
- **Building 506** – The stainless steel holding tank on the north side of the building was decontaminated three times before acceptable radiation/contamination levels were obtained. The tank was removed by the shipyard and used for boiler feed water storage. All contaminated equipment in Rooms 35 and 35A was either disposed of as radioactive waste at a licensed off-site disposal facility or crated and shipped off site as radioactive material to another licensed facility that could make use of the equipment. Rooms 35 and 35A were washed with hot water and steam cleaned to remove residual contamination. Rooms 33 and 33A contained several localized areas of H-3 contamination that were scrubbed with decontamination detergent. The filter housing on the roof was removed and disposed of off site as radioactive waste (HRA-1479, pp 13-14).
- **Building 529** – Radiological surveys and swipe sampling were conducted. The results showed no detectable radiation (HRA-1479, p 14).
- **Building 707** – Building was surveyed and decontaminated to background levels and released by NRDL for unrestricted use in 1969 (HRA-1479, p 4).

- **Building 815** – Each floor of Building 815 was decontaminated by washing affected areas and dismantling radioactive equipment, which was then packaged and disposed of off site. Areas were released after final surveys found no contamination at or above release levels. Two storage tanks on the west end of the building were cleaned by rinsing with a fire hose. One tank was then filled with water, and a sample of the water was collected. When alpha, beta, and gamma radiation were not detected in water, it was transferred to the second tank. The water from the second tank was sampled and also tested for alpha, beta, and gamma radioactivity. When no contamination greater than release levels was found, the tanks were released as clean (HRA-1479, pp 4-9).
- **Building 816** – The Van de Graaff generator was removed and shipped to the Naval Ammunition Depot in Crane, Indiana, for reuse. The building was steam cleaned. Survey results showed that H-3 contamination had been successfully removed (HRA-1479, pp 9-10).

No material remaining in Buildings 364, 506, 529, 815, or 816 yielded detectable levels of radioactivity that exceeded the release limits using detection equipment available at that time. Isolated areas of residual radioactivity remained in the vicinity outside of Building 364 after decontamination was completed, but radioactivity levels were well below AEC's maximum permissible concentrations. Radioactivity was detected in the yard behind Building 364, primarily on the floor of the concrete tank pit and on the demolished shack floor slab. Also, the remaining pipe under the Building 364 concrete slab had a reading of 0.5 mrem/hr (HRA-1479, p 16).

6.4.4 1969 to 1970 AEC Surveys

From 15 September 1969, through 30 January 1970, AEC visited HPS 22 times to conduct confirmatory surveys of facilities previously used or being vacated by NRDL. The surveys included Buildings 364 (and the yard), 365, 506, 517 (containing the Co-60 irradiation room), 529, 815, and 816 and the Building 707 area concrete waste preparation pad (HRA-1038). Documentation showed that no G-RAM was housed in Buildings 820 and 821; therefore, AEC release for these buildings was not required (HRA-1479, p 20).

AEC granted final clearance based on an independent survey consisting of spot checks for radioactivity in areas previously cleared by the NRDL Health Physics Division. The surveys included measuring alpha, beta, and gamma radiation levels and swipe sampling to test for

removable contamination. Alpha readings were taken only in areas where alpha contamination may have occurred, which included the sixth floor and rooms 179, 222, 218, 218A, 1109, 4125, 4129, and 4181 of Building 815. The liquid waste storage tank pit behind Building 364 was also surveyed for alpha contamination. Swipe samples from these locations were counted for beta-gamma, and samples showing 100 dpm or more were then counted for alpha levels (HRA-1038).

The survey results demonstrated that the former NRDL facilities met permitted regulatory levels (called *de minimis*) required for release for unrestricted use (HRA-1038; HRA-2998). These levels were as follows:

- Average beta-gamma dose rate at 1 centimeter above the surface less than 0.2 mrem/hr
- Beta-gamma removable activity less than 1,000 dpm/100 cm²
- Alpha fixed activity less than 500 dpm/100 cm²
- Alpha removable activity less than 100 dpm/100 cm²

The drain in Building 364, which read 0.07 mR/hr, was filled with concrete as an additional control measure and remained in place after release (HRA-1479, p 16).

AEC's final report documented release of Buildings 364, 365, 506, 517, 529, 815, 816, and 707 and ICW 418 (HRA-1038).

6.4.5 1974 HPS Survey for Base Closure

HPS was disestablished in 1974. All radiological operations conducted by the shipyard were suspended. Surveys were required to ensure that areas where licensed G-RAM-related operations were conducted met applicable radiological release criteria. All shipyard facilities involving G-RAM-related operations were decontaminated as necessary and surveyed prior to release. However, available documentation does not indicate survey or decontamination procedures. Known information is summarized below.

In August 1974, the shipyard surveyed Buildings 113A, 146, 214, 253, and 351A for residual contamination. These buildings were released for unrestricted use based on the survey results (HRA-2964).

At Building 351A, shipyard personnel collected swipe samples and took direct radiation reading measurements. Beta contamination was discovered in the sink and associated drain lines in Workroom 47. The sink was removed, and the building was released for unrestricted use.

6.4.6 April 1978 LFE Survey of Building 815

In April 1978, LFE conducted an independent Characterization Survey at Building 815 to assess potential residual G-RAM. NRC's allowable radiation levels changed between 1969 and 1978, and the survey was conducted at the request of the General Services Administration (GSA). GSA was interested in using the building and wanted to ensure it met the revised limits. The Characterization Survey consisted of alpha, beta, and gamma scans of each room in Building 815. Swipe samples were also collected at 76 locations for gamma spectral analysis. The results of the survey are summarized below (HRA-2957).

- Room 1109 required more extensive decontamination. Heating and air ducts were contaminated with Cs-137. The survey report recommended further investigation and decontamination.
- Levels found in the fume hood ducts slightly exceeded room background levels. The report recommended that the ducts be sealed off or removed.
- Anomalies were detected on a desk in Room 135, a sink in Room 218, a bench in Room 471, tiles in Room 631, and the fume hood in Room 670. The survey report recommended that the desk, sink, bench, and tiles be either discarded or decontaminated and that the fume hood be either decontaminated or painted to fix the residual G-RAM in place and the location noted.

6.4.7 July 1978 RASO Survey of Building 815

On 27 and 28 July 1978, RASO conducted a radiological survey to validate LFE's survey results for Building 815. RASO's survey of Building 815 focused on the rooms identified by LFE as containing residual G-RAM. RASO also surveyed other randomly selected rooms and the heating and air conditioning system. The survey consisted of beta-gamma and alpha scans and swipe sampling for removable alpha and beta-gamma activity. Swipe samples were collected from 247 points in 22 different locations throughout the building. A powdery substance from ceiling air conditioning and heating intakes at various locations was also sampled (HRA-3001).

Based on the new release limits published in *AEC Regulatory Guide 1.86 (June 1974)* (HRA-2939), Building 815 contained isolated “hot spots” in ducts that served identified G-RAM use locations and other limited locations. Eight of the 247 locations surveyed indicated results exceeding these release limits (HRA-3001, pp 3-4).

RASO recommended a more detailed investigation of G-RAM use locations. Further recommendations included (HRA-3001, pp 4-5):

- Detailed beta-gamma radiological surveys of all rooms on the fourth, fifth, and sixth floors; Health Physics Division Rooms 218, 222, 255, and 2153 on the second floor; and Room 1109 on the first floor.
- Random alpha surveys of all rooms on the sixth floor and detailed alpha surveys in rooms where radioactivity levels approached acceptable limits.
- Evaluation of each air conditioning and heating duct intake and exhaust, fan blades, and filter areas for air handling units serving areas identified as requiring a more detailed survey.

6.4.8 September 1978 RASO Surveys of Other NRD L Buildings

After the confirmation that residual G-RAM levels at Building 815 exceeded the revised NRC allowable limits, RASO conducted cursory surveys at other former facilities that potentially could exceed the revised contamination limits (HRA-3002). On 30 September and 1 October 1978, RASO surveyed Buildings 113A, 364, 365, 506, 517, 529, 707, and 816. The surveys consisted of alpha and beta-gamma scans and swipe sampling for alpha and beta-gamma activity. Soil, paint scrapings, wood scrapings, and other bulk samples were collected for radionuclide content analysis.

Radioactivity levels were less than the instrument minimum detectable activity (MDA) of 64 dpm in Buildings 113A, 365, 517, 529, 707, and 816. Building 364 still contained G-RAM at levels exceeding BUMED limits and NRC guidelines. The building was recommended for further investigation. In addition, three isolated spots with beta-gamma activity were detected in Building 506, but the activity was well below NRC guidelines. A total of 267 cubic feet of waste packed in ten 55-gallon drums and two 6-by-4-by-4-foot plywood boxes were generated. Southwest Nuclear Company of Pleasanton, California, removed the waste for disposal.

6.4.9 1979 RASO Resurvey of Buildings 364, 815, and 816

Based on 1978 survey recommendations, RASO conducted additional surveys at Buildings 364, 815, and 816 in 1979 to assess whether they still met NRC's revised allowable radiation and contamination limits. Survey activities included detailed radiological surveys, decontamination of all areas identified as having residual radiation activity, and a post-decontamination survey (HRA-3007 Encl 1, p 11). Building-specific findings and activities are discussed below.

6.4.9.1 Building 364

Decontamination of Building 364 was achieved by the "survey-clean-survey" method. Areas of known or suspected contamination were surveyed by direct reading over a 1-by-1-foot grid system, with fixed readings at each corner and at the center of each grid. Swipe samples on a 1-meter square grid were collected. Decontamination was accomplished by paint removal and concrete chipping. Decontaminated areas were then resurveyed to verify that the decontamination was effective (HRA-3007 Encl 2).

6.4.9.2 Building 815

The detailed radiological survey of Building 815 focused on areas found to be contaminated during the July 1978 RASO survey. The areas of concern included Room 1109 on the first floor; Rooms 218, 222, 255, and 2153 on the second floor; radioactive sources on the fourth floor; the Biological and Medical Sciences Division on the fifth floor; and the entire sixth floor (HRA-3007 Encl 1).

The survey included surface beta and alpha scans using a grid system on floors, walls, bench tops, and fume hood interiors. Areas with higher than average readings within the grid, the fume hood, and exhaust ducts were also swipe sampled for H-3 and carbon-14 contamination.

Decontamination procedures at Building 815 included the following (HRA-3007 Encl 1, p 10):

- Removing flooring, contaminated ceramic sinks, and contaminated surfaces
- Removing paint
- Chipping concrete
- Cleaning with detergent all cabinet, light fixture, and crane rail top surfaces in Room 1109 and contaminated fume hood interiors
- Vacuuming accumulated dust from duct interiors
- Power sanding or manual scraping using a carbide-tipped scraper on metal surfaces, and removing contaminated floor blocks in the machine shop (Room 407) by sawing
- Removing plumbing parts, including contaminated valves and valve handles

6.4.9.3 Building 816

Building 816 surveys indicated no measurable contamination using the same instruments used during the 1978 RASO survey; however, this building had a history of H-3 use, and the instruments used in 1978 were not capable of measuring H-3 (HRA-3007 Encl 2, p 1). Therefore, the building was resurveyed using appropriate instruments in October 1979. Swipe samples were collected from five locations throughout the building. On average, one swipe sample was collected for every 50 square feet of floor and wall space. Swipe samples were collected from the target pit, target room, magnet room, laboratory, and accelerator room. RASO analyzed the swipe samples for low-energy beta radioactivity (HRA-2998 App A; HRA-3007).

Survey results of those areas indicated that surface radiation levels for fixed and removable contamination met *AEC Regulatory Guide 1.86* guidelines (HRA-3007 Encl 2, p 6).

Final results of the decontamination effort and resultant survey were submitted to NRC, who agreed that the buildings met NRC guidelines for unrestricted use (HRA-1040).

6.4.10 1986 EPA NNPP Operation Investigation

In 1984, the NAVSEA requested that EPA conduct harbor surveys at all active facilities servicing nuclear-powered warships. These surveys were to assess levels of environmental radioactivity resulting from the maintenance and operation of nuclear-powered warships and to evaluate whether these activities posed significant exposure risks to potential human receptors or resulted in significant environmental contamination. In September 1986, EPA collected bottom

sediment, water, and biological specimens near the drydocks and pier areas at HPS, including Drydocks 2, 3, and 4 and Berths 2 and 17, where nuclear-powered warships had been berthed or serviced (HRA-2951).

The study focused on Co-60 because it was the predominant radionuclide associated with NNPP operations. However, the gamma spectroscopy performed would have also identified other gamma-emitting radionuclides if they were present. Water samples were also analyzed for H-3.

This investigation included both field gamma radiation surveys and sample analyses. An underwater gamma survey was conducted using a sodium iodide (NaI) scintillation detector to locate any areas of elevated radioactivity. Sediment samples were collected from the detector measurement locations. One core sample was collected from the Drydock 4 area to determine the vertical distribution of radioactivity in harbor bottom sediment, and surface water samples were also collected near this drydock. Vegetation (sea lettuce) and mussel samples were collected from the Bay.

The underwater gamma scintillation probe did not detect any areas on the harbor floor where radioactivity levels exceeded background levels. Only naturally occurring nuclides and trace quantities of Cs-137, at levels typically associated with fallout from previous worldwide nuclear weapons testing, were detected in the sediment samples. Surface water samples contained no H-3 exceeding the MDA of 200 picocuries per liter (pCi/L). Potassium 40 (K-40), a naturally occurring radionuclide, was the only gamma-emitting radionuclide detected. Biological samples of sea lettuce and mussels all contained small quantities of naturally occurring radionuclides. The gamma exposure rates averaged 4.4 ± 0.4 microrems per hour ($\mu\text{rem/hr}$), which is comparable to measured background levels of 4.1 ± 0.2 $\mu\text{rem/hr}$ (HRA-2951, pp 13-14).

This radiological survey concluded that only naturally occurring radionuclides and trace amounts of Cs-137 from fallout were detected at HPS. Based on this survey, EPA concluded that operations related to nuclear-powered warship activities contributed no detectable radioactivity to Drydocks 2, 3, or 4 or Berths 2 and 17 (HRA-2951, p 15).

6.4.11 1988-1989 HLA Site Reconnaissance

In 1988, HLA conducted a preliminary surface radiation survey to determine if radioactivity levels at HPS posed unacceptable exposure risks to RI field workers. Project activities included a scintillation survey for radiation at surface locations at the Industrial Landfill (IR-01/21), the Bay Fill Area (IR-02), and the Submarine Base Area (Sub-Base Area) (IR-07). Radioactivity was also measured at other HPS and Bay area locations to determine background levels. Survey results were compared with established background levels to determine whether G-RAM sources were present in or near the surface. Survey results indicated gamma readings exceeding background levels, and additional investigation of these anomalies was recommended (HRA-2958, pp 17-19).

Gamma counts were measured at predetermined on- and off-site locations to obtain background data and at the nodal points of a 50- by 50-foot grid. Gamma scintillation counts were measured at ground surface and at 1 meter above ground surface at each grid node and along grid lines.

The Industrial Landfill surface gamma survey was conducted at grid points over the entire landfill. The average gamma count rate was determined to be significantly below the mean of the background values measured at HPS. Surface gamma counts at one location in the landfill exceeded the average level at the landfill but were close to the mean of the HPS background values. A pile of shale and serpentinite gravel in the northwest corner of the landfill also exhibited elevated gamma readings, but they were below the mean of the background gamma levels. These elevated readings were attributed to natural radiation within the shale and serpentinite bedrock gravel (HRA-2958, p 50).

An area of five anomalous gamma readings in the Bay Fill Area (IR-02) was surveyed in more detail using a 10-by-10-foot grid spacing, as well as a ground scanning method. Twenty-four elevated readings were detected using the 10-by-10-foot grid spacing, and 8 more were identified using the ground scanning method. Anomalies detected between grid nodes were recorded, mapped, and included in a database. The Bay Fill Area surface gamma survey also

indicated some small, discrete areas in IR-02 Northwest, where gamma counts exceeded background but did not exceed the reporting limits of that time (HRA-2958, p 41).

The Sub-Base Area gamma survey showed that levels detected were within the natural background for HPS and the Bay Area.

6.4.12 1991 to 2001 Remedial Investigation Surveys

In 1991, the Navy began radiation investigations at HPS in four main phases as part of the RI program. Activities conducted under each phase are briefly summarized below.

- Phase I consisted of a surface confirmation radiation survey (SCRS) that included air, soil, and groundwater sampling (HRA-593).
- Phase II focused on the subsurface distribution of radioactive point sources detected in the top 1 foot of soil during Phase I (HRA-2993).
- Phase III focused on radiological issues related to (1) NRDL operations at HPS, (2) the licensing of G-RAM use by the NRC in support of NRDL activities, and (3) preliminary findings for buildings and sites used by NRDL in Parcel B (HRA-2997).
- Phase IV was performed to quantify ambient concentrations of specific radionuclides and to further characterize contamination sites outside Buildings 364 and 707 (HRA-3011).

Each of the four phases and related interim investigations is summarized below.

6.4.12.1 Phase I Radiological Investigation

The Phase I radiological investigation was conducted in two stages: (1) air monitoring and (2) the SCRS. Phase I particulate air monitoring was conducted from August through September 1991 to determine the background airborne particulate alpha and beta radioactivity levels in and around IR-01, IR-02, and IR-05. Groundwater samples were also analyzed for gross alpha and gross beta radioactivity to determine whether the presence of radium-bearing devices in soil was impacting groundwater (HRA-593).

The Phase I SCRS was initiated in 1992 to determine and confirm the nature and surficial extent of radium-bearing devices in the disposal area at the Bay Fill Area (IR-02 Northwest). The Phase I SCRS included the Industrial Landfill (IR-01/21), the Bay Fill Area (IR-02), IR-03,

the Sub-Base Area (IR-07), IR-14, IR-15, the Waste Oil Disposal Area (IR-18), and IR-19. Field activities included a walkover surface gamma survey, soil sampling and analysis, radon flux testing, groundwater well sampling, and down-hole gamma radiological surveys inside the casings of groundwater monitoring wells. In addition, cursory surveys were conducted at the following former NRDL sites: Buildings 364 (referred to as Building 351A in PRC Environmental Management, Inc. [PRC] 1992 report), 701, and 816 and Drydock 4 (HRA-2984).

The investigation techniques and findings are discussed below.

6.4.12.1.1 Investigation Techniques

A grid coordinate system was developed to map and locate G-RAM detected during the 1988 surface walkover survey. Each grid square measured 300 by 300 feet and was further subdivided into 30-by-30-foot sub-grids. Health physics technicians performed the surface gamma walkover survey using 2-by-2-inch NaI detectors coupled to rate meters to detect gamma-emitting radioactive material within the Landfill Area. During the Phase I radiological investigation, gamma readings exceeding two times the background level were considered potential G-RAM anomalies associated with buried radium-containing devices. Background levels were determined on a sub-grid-specific basis (HRA-2984).

When elevated gamma readings were observed, the location, gamma measurement, and exposure measurement were recorded, and a biased soil sample was collected to identify radionuclides. To provide additional characterization information, soil samples were also collected at random unbiased locations throughout the Parcel E area at a frequency of one sample per 2 acres. All soil samples were analyzed at an off-site laboratory using gamma spectroscopy to identify and quantify gamma-emitting radionuclides.

Radon flux canisters were placed on ground surfaces at selected locations at and around areas of anomalous readings to attempt to detect radon gas, a radioactive gas emitted by the decay of Ra-226. Increased radon concentrations might indicate the presence of subsurface radium-containing devices. Radon released during the Ra-226 decay process would be captured by adsorption to carbon in the flux canister. Canisters were removed after a 24-hour exposure period and analyzed at an off-site laboratory using gamma spectroscopy.

Seven groundwater samples were collected and tested for alpha, beta, and gamma radioactivity. Gamma spectroscopy was used to identify gamma-emitting radionuclides. Six wells in IR-02 and one well in IR-07 were tested. A down-hole gamma radiation survey was performed inside the casing of the same wells from which the groundwater samples were collected. A NaI scintillation detector was lowered to the water level, and the gamma count rates were recorded at 1-foot intervals.

In addition, Buildings 351A, 701 (in ruins), 816, and Drydock 4 were surveyed using both NaI scintillation and Geiger-Mueller detectors (HRA-2984).

6.4.12.1.2 Findings

The gross alpha and gross beta airborne particulate concentrations were well within safety standards for airborne concentrations of G-RAM in ambient air (HRA-2984).

During the surface walkover survey, nine radioactive point source anomalies associated with radium-containing devices were observed in the southwestern and northeastern portion of IR-01/21. Over 300 radium-containing point sources (such as instrument dials, glass beads, and gauges) were observed in a centralized area at IR-02 Northwest that extended about 50 feet across the site boundary into IR-02 Central. This area corresponds to one of the HPS industrial waste disposal areas. The anomalous area measured about 600 by 600 feet and was centered about 500 feet west of Building 600. Radium-containing devices were observed on the ground surface at IR-02 Northwest and were removed prior to soil sample collection. A few elevated gamma readings were observed in the inter-tidal area at IR-02 Northwest. One G-RAM point source anomaly was observed at IR-02 Central, east of the Building 600 parking lot. A few elevated gamma readings were observed at scattered locations at IR-02 Southeast, but no radium-containing devices were identified at these locations. At IR-07 and IR-18, areas with anomalous readings were observed in light brown sand exposed on the slopes at the Donahue Street boundary. Gamma activities exceeding the site background value by more than 50 percent and general area gamma activities were noted. No anomalies were detected at the shoreline.

Areas containing sandblast waste were scattered throughout the IR-14 area. G-RAM point source anomalies were not found at IR-03, IR-14, IR-15, or IR-19, but a combination safe

at IR-14 had elevated gamma activity associated with a dial and handle on its door. The safe was moved to a low-level radioactive waste (LLRW) container within Building 414. The safe was moved to Building 130 in 1995 prior to off-site disposal. Phase I SCRS results resulted in a recommendation for further investigation.

Soil samples contained Ra-226, its daughter products, and other naturally occurring radionuclides. Except for Ra-226 and its daughters, no concentrations exceeded background levels. A few samples from IR-01/21 and IR-02 Central and many samples from the disposal area at IR-02 Northwest contained radium-bearing devices that were removed before laboratory analysis of the associated soil. These radium-bearing devices were placed in properly labeled drums and stored in the LLRW structure within Building 414 and then moved to Building 130 prior to off-site disposal.

Elevated levels of radon gas were observed mainly at IR-02, where radon flux canisters were placed directly on top of radium-bearing devices at the ground surface. Flux canisters placed at locations where radium-bearing devices were not visible did not detect radon gas above background levels. Gross alpha and beta levels were not elevated in the air samples collected from and around Parcel E.

Groundwater samples were collected at three wells in IR-02 Northwest, one well in IR-02 Central, two wells in IR-02 Southeast, and one well at IR-07. However, because dissolved and suspended solids in the groundwater samples interfered with analysis, the results were inconclusive in determining the presence of radioactivity. Six of the seven monitoring wells that underwent the down-hole gamma radiation survey exhibited elevated count rates that were considered indicative of bentonite seals in the borehole annulus around the well casings (HRA-2984).

Building and structure specific survey results from a hand-held scanning instrument are summarized below (HRA-2984).

- **Building 351A (Misidentified in the Phase I Radiological Investigation Report (HRA-2984). Actually, Building 364)** – Elevated alpha and gamma activity was measured at one of the trenches. Additional investigation of the sump area was recommended.
- **Building 701** – No radiation anomalies were detected.
- **Building 816** – Alpha, beta, and gamma activities levels were comparable to background levels.
- **Drydock 4** – No radiation anomalies were detected.

6.4.12.2 Phase II Radiological Investigation

The Phase II radiological investigation was conducted at Parcels B and E from 21 January through 25 July 1993, in an attempt to delineate the subsurface distribution of radium-containing devices at the IR-01, IR-02, IR-07, and IR-18 fill areas (HRA-2993).

The investigation techniques and findings are summarized below.

6.4.12.2.1 Investigation Techniques

To delineate the subsurface distribution of G-RAM point sources in the fill areas, 27 15-foot-deep test pits and three 100-foot-long trenches were excavated at IR-02 Northwest. One of these trenches extended about 40 feet across the site boundary into IR-02 Central.

Seven 15-foot-long test pits were excavated at IR-02 Central along the IR-02 Northwest site boundary. Six 15-foot-long test pits were excavated at IR-01/21. The excavation locations were chosen to:

- Include known and potential areas of elevated radiation based on Phase I radiological investigation results and historical information,
- Provide detailed soil stratigraphy data, and
- Identify the types and depths of buried debris associated with radiation anomalies.

The trenches and test pits were excavated until either Bay mud or groundwater was encountered or until the walls of the excavation became unstable. Trench and test pit depths ranged from 2.5 to 10.5 feet bgs, with an average depth of about 8 feet bgs. Buried radium-bearing devices found in subsurface soils were removed, placed in properly labeled drums, and

stored in the LLRW storage area in Building 414. The drums were later moved to Building 130 prior to off-site disposal. A trench pit was excavated in both IR-07 and IR-18. The two pits contained silty sand approximately 1-foot thick at the surface. Sandstone bedrock was encountered at 2.5 feet bgs in IR-07. Weathered serpentinite bedrock was encountered at IR-18 (HRA-2993).

Using 2-by-2-inch NaI detectors, health physics technicians scanned the walls of each excavation at 2-foot intervals. When elevated gamma readings were observed, the locations, gamma measurements, and exposure measurements were recorded. Gamma count rates exceeding 1.5 times the background level were considered G-RAM point source anomalies associated with buried radium-containing devices. G-RAM source locations were further investigated by excavation. If radium-bearing devices were found, the device(s) and soil samples were collected. The samples were analyzed at an off-site laboratory using gamma spectroscopy to identify and quantify gamma-emitting radionuclides (HRA-2993).

Down-hole gamma logging was performed at 22 groundwater monitoring wells using a gamma detector. Five soil cores were collected to measure the air permeability of the soil to evaluate radon gas flux rate measurements obtained during the Phase I radiological investigation. Four cores were collected from IR-02 and one from IR-07.

High, medium, and low volume air sampling was performed during excavation activities to determine the concentrations of airborne radioactive particulates (HRA-2993).

6.4.12.2.2 Findings

One well surveyed during the down-hole gamma logging showed gamma activity. This was considered indicative of a bentonite seal as in Phase I. The air permeability testing during the Phase I investigation was not considered a good indicator of radon flux measurements. Therefore, this test was deemed not useful in detecting buried Ra-226 sources. Gross airborne alpha and beta particulate activity did not exceed 10 percent of standards in Title 10 of the CFR, Part 20. Site-specific findings are summarized below (HRA-2993).

- **IR-01** – No elevated gamma count rates were measured in the test pits or trenches.
- **IR-02** – Of the 34 test pits and 3 trenches excavated, 12 test pits and 2 trenches contained a total of 111 gamma-emitting anomalies. A total of 96 point sources indicating radium-containing devices were found between the ground surface and 6.5 feet bgs in these areas. Ra-226, lead-214 (Pb-214), bismuth-214, and Ra-226 daughters were detected at the site.
- **IR-02** – Four excavations exhibited a gamma count rate distribution that differed from the other excavations. A large proportion of the elevated gamma count rates were correlated with the presence of firebrick.
- **IR-02** – Two test pits contained crushed or decomposed radium-bearing devices with a small volume of contaminated soil around them.
- **IR-07 and IR-18** – No point sources of elevated gamma activity were detected in the test pits.

6.4.12.3 Phase II to Phase III Interim Investigations

The seven interim investigations discussed below were conducted between the Phase II and Phase III radiological investigations.

6.4.12.3.1 1993 PRC H-3 Study

In May 1993, the Navy sampled surface soils and paving materials around Building 816 for H-3. Previous survey and release data during NRDL disestablishment and subsequent NRC verification were obtained from inside the building only. CDHS expressed concern that NRDL personnel may have tracked H-3-contaminated wastewater from inside the building to exterior soils and pavement and recommended further surveys outside. Sampling locations were selected based on site visits and discussions with a former NRDL employee and RASO representatives.

Surface soil samples were collected approximately 6 inches from walkways and from the building foundation. This selection was based on the assumption that water runoff would flow into soil immediately downgradient and adjacent to a walkway or paved area. Concrete and asphalt samples were collected from beside the building foundation out to 2 feet from the building, based on an assumed walking path. The pavement was broken so soil below the paving material was sampled. Concrete and asphalt samples were collected using a pneumatic chisel.

Survey results confirmed that all the H-3 results were below the MDA of 0.5 picocuries per gram (pCi/g). CDHS conducted an independent outdoor survey and confirmed the Navy's findings (see below) (HRA-2998).

6.4.12.3.2 1993 CDHS H-3 Study

CDHS conducted an independent confirmatory soil sampling for H-3 to verify the results of the Navy's study at Building 816. Four soil samples were collected around the building and sent to the CDHS Sanitary and Radiation Laboratory for H-3 analysis. The results showed that H-3 concentrations were all below the detection limit of 2.35 pCi/g; these results confirmed that H-3 activity was within background levels. EPA concurred that no further actions were required (HRA-2945).

6.4.12.3.3 1993 EPA Study of Parcel E Soil

EPA's National Air and Radiation Environmental Laboratory (NAREL) analyzed 13 soil samples from Parcel E (IR-02) to determine particle size, radionuclide distribution, and radionuclide content. Three of the samples contained elevated levels of Ra-226. The remainder contained Ra-226 at concentrations comparable with background. Depending on the soil sample collected, different distributors of Ra-226 were found. Ra-226 was sometimes found to be approximately equal between particle-size fractions, sometimes preferring the smaller fractions, and therefore indicating contamination by oxidation or fragmentation.

The study concluded that, based on the background concentrations detected in 10 of the 13 samples, a significant volume of Parcel E soil may contain background levels of Ra-226. The report also concluded that, based on the soil particle-size distribution in Parcel E, particle-size separation could be accomplished by hydro-classification or sieving with equipment typically used by the mineral processing industry to remove radium sources. The evaluation of elevated soil radioactivity indicates that sources had apparently released radium into immediately adjacent soil. Therefore, removal of the radium sources should also be accompanied by removal of contaminated soil in the immediate vicinity of the radium sources (HRA-2954).

6.4.12.3.4 1994 EPA Petrographic Study of Parcel B

EPA's NAREL conducted this study to evaluate the use of a soil sieving treatment technology for removing radium from soil around the buried radioluminescent devices in Parcel B (HRA-2953). A previous study determined that part of HPS could potentially be remediated through removal of soil, identifying Ra-226 sources, and removing the sources from soil by particle-size separation (HRA-2954).

NAREL collected three soil samples from IR-07 and IR-18 for petrographic and radiological analysis. The soil's mineralogy (particle size, mineral type, and other physical characteristics) was established using petrographic analysis. Its radioisotopic constituents were identified by gamma spectroscopic analysis. This information was used to determine whether the soil composition was natural or contained remnants of radioactive material from past Navy operations.

EPA's petrographic analysis concluded that Parcel B soils contain naturally occurring radioactive isotopes of the uranium and thorium decay series. These radioactive materials, including Ra-226, are naturally present in the granitic minerals, monazite and zircon. The report further concluded that the radioactive material content of Parcel B soil had not been depleted or enhanced by any manufacturing process. The study stated that the soil had been imported from another location in California for use as fill at HPS and would not be amenable to the originally proposed treatment technology (HRA-2953).

CDHS concurred with EPA's technical findings and recommended the release of IR-07 and IR-18 in 1995 (HRA-2946).

6.4.12.3.5 1994 Drydock 4 Surveys (MINS and PRC)

An earlier radiological investigation performed by MINS personnel identified a possible Ra-226 point source at Drydock 4. MINS personnel did not remove the point source because it did not contain Co-60, the radionuclide of concern for the survey (HRA-2951). Subsequently, MINS conducted another survey on 21 July 1994, and removed the Ra-226 point source (HRA-2960). In September 1994, PRC conducted a radiological survey at the drydock to confirm

that no radioactivity exceeding background levels remained (HRA-2987, p 1). The radiological survey consisted of a 100-percent walkover gamma survey of the drydock floor area using a NaI detector, a gamma detector, and an exposure rate survey instrument. Sediment samples were also collected at each location where an anomalous gamma count rate was observed for gamma spectroscopic analysis.

This survey confirmed that no G-RAM remained at the drydock exceeding background levels. The Navy leased Drydock 4 to a civilian business in September 1994 (HRA-2960; HRA-2987).

6.4.12.3.6 1996 ATG Building 364 Peanut Spill Remediation

Allied Technology Group, Inc. (ATG) performed an interim removal action at the Cs-137 spill area behind Building 364 (also known as the “peanut spill”) in 1996 (HRA-2941). This contaminated area of asphalt was discovered in 1993 during the Parcel D RI (HRA-2994; HRA-2995, pp 11-13). Initial site radiological surveys consisted of screening with scintillation and Geiger-Mueller detectors, collecting swipe samples, and sampling soil prior to the removal action. ATG excavated the peanut-shaped area to approximately 4 inches bgs and removed a total of 30 cubic feet of soil. The area was then resurveyed, and 20 confirmatory soil samples were collected for Cs-137 analysis. Sample results ranged from 0 to 1.2 pCi/g of Cs-137, with an average of 0.34 pCi/g. These levels were within the NRC Technical Report Nuclear Regulatory Guide (NUREG)-1500 limit of 2.14 pCi/g, at the 3 mrem per year level for residential areas, which was the release limit of the period (HRA-2941).

6.4.12.3.7 IDW Investigation

As a result of RI activities that were conducted at IR-01/21, IR-02, IR-03, IR-07, and IR-18, investigation-derived waste (IDW) containers were identified as potentially containing radioactive material. Preliminary radiological surveys of the drums and bins were generally conducted prior to off-site disposal. These containers were initially stored in controlled areas within Building 810. The drums were later transferred to Building 414, and then again to Building 130 for storage prior to disposal (HRA-2990). The typical screening process consisted of weighing each drum, measuring the gamma exposure rate using a 2-by-2-inch NaI detector, and collecting samples from approximately 250 drums for laboratory analysis (HRA-2986).

In December 1994, PRC recommended reducing the volume of IDW to be screened by limiting the amount of IDW to be generated at IR-02, IR-07, and IR-18 based on existing survey and sample results. Drums that did not require a radiological survey were disposed of using normal procedures (HRA-2990; HRA-2988).

In 1997, New World Technology (NWT) performed a disposal action on all remaining bins and containers housed in Building 130 that had exceeded the previously established count rate. A radium-bearing dial from a safe was also disposed of. Other than those drums known to contain sources retrieved during the Phase I and II radiological investigations, no other drums were identified as containing radioactive materials (HRA-2983).

6.4.12.4 Phase III Radiological Investigation

The PRC Phase III radiological investigation was conducted from 1996 to 1997. It was intended to address concerns regarding the use, storage, and disposal of radioactive material during past NRDL operations at HPS. The goal of this phase was the eventual release of all remaining buildings and sites in Parcels D and E for unrestricted use. The effort included Buildings 351A, 506 through 510, 510A, 517, and 529; the Building 364 Cs-137 peanut spill area; and the Building 707 concrete pad area.

Phase III radiological investigation techniques and findings are discussed below.

6.4.12.4.1 Investigation Techniques

Phase III investigations consisted of surface gamma walkover surveys and collection of soil, asphalt, concrete, and swipe samples (HRA-2994). Ten-by-10-foot square grids were established to map and identify anomalies detected during the surveys. A global positioning system was used for reference. The walkover survey was performed using a NaI detector. Additionally, a static (fixed location for a specified period of time) gamma survey was performed. When elevated gamma readings were observed, the location, count rate, and exposure rate measurements were recorded. Soil samples were collected at those locations to determine which gamma-emitting radionuclides were present above background levels. Swipe samples were collected from the surface of the Building 707 concrete pad. All samples were

analyzed by gamma spectroscopy at an off-site laboratory to determine the amount and identification of radionuclides that might be present.

6.4.12.4.2 Findings

Phase III radiation investigation report recommendations are summarized below (HRA-3009).

- Building 351A may be considered for release by the Navy for unrestricted public use.
- Additional investigation must be performed at the wall of the sump and the utility trench wall at the Building 364 sump site.
- No recommendation was presented for Building 506.
- The area around the anomalous count rates at Buildings 509 and 517 should be assessed for a potential removal action.
- The potential buried point source behind Building 529 should be excavated and removed.
- Additional investigation at Building 707 and the concrete pad is needed to determine the nature and extent of the elevated Ra-226, thorium-228 (Th-228), and Th-232 concentrations and to determine whether removal is necessary.
- Buildings 507, 508, 510, and 510A can be released for unrestricted public use.

6.4.12.5 Interim Parcel E Radiation Risk Assessment

As part of the Parcel E draft final RI, Tetra Tech EM Inc. (TtEMI) performed a radiation risk assessment to evaluate potential risks associated with human exposure to radionuclides detected at Parcel E. The risk assessment was presented as Appendix P of the Parcel E RI report (HRA-3009, pp P-1 to P-63).

The risk assessment evaluated exposures and risks to human health under future residential and industrial land-use scenarios for five sites in Parcel E: IR-01/21, IR-02 Central, IR-02 Northwest, IR-02 Southeast, and IR-11/14/15. Ra-226 and its radioactive daughters (lead-210 [Pb-210] and radon-222 [Rn-222]) were identified as radionuclides of potential concern. The sources of these radionuclides are radium-containing devices from ship repair and maintenance activities that were disposed of in IR-02 Northwest and Central. Data collected as

part of the Phase I through Phase III radiological investigations were used to conduct the risk assessment.

For purposes of the risk assessment, Parcel E was divided into 0.5-acre and 2,500-square-foot exposure areas to represent industrial and residential land use, respectively. A total of 147 residential and 35 industrial areas were evaluated in the risk assessment. For each residential and industrial exposure area, an exposure point concentration was calculated based on the number of anomalies observed during the Phase I through Phase III radiation investigations.

Under the residential land-use scenario, residents were assumed to be exposed to radionuclides through ingestion of soil, inhalation of airborne particles, ingestion of homegrown produce, inhalation of Rn-222 gas, and external exposure. Under the industrial land-use scenario, workers were assumed to be exposed to radionuclides through ingestion of soil, inhalation of airborne particles, inhalation of Rn-222 gas, and external exposure.

Information from data evaluation, exposure assessment, and toxicity assessment were compiled and used in the DOE computer modeling program "RESRAD." RESRAD models a time-dependent source term that accounts for radioactive decay and leaching and erosion in the contaminated zone and considers site-specific geologic and hydrogeologic parameters. RESRAD was used to estimate the excess lifetime cancer risk (ELCR) that would result from exposure to Ra-226 and its decay products for residents and workers at Parcel E. EPA has established an "acceptable" risk range for carcinogenic risk from exposure at a Superfund site of 1×10^{-6} to 1×10^{-4} . In general, a potential ELCR of 1×10^{-6} is used by EPA as a point of departure for determining remediation goals.

Risks were quantified for exposure to Ra-226 in soil and to its resulting daughter product Rn-222 in indoor air. Because the Rn-222 risk is relevant only if buildings are constructed in the contaminated areas, this risk was assessed separately (HRA-3009).

For exposure to Ra-226, all of the 147 residential exposure areas had total ELCRs greater than 1×10^{-6} and less than 1×10^{-4} for the reasonable maximum exposure (RME) scenario. For the average exposure scenario, 51 residential exposure areas had total ELCRs greater than

1×10^{-6} , and no residential exposure areas had total ELCRs greater than 1×10^{-5} . Of the 35 industrial exposure areas, nine had ELCRs between 1×10^{-6} and 1×10^{-5} for the RME case, and 26 industrial exposure areas had ELCRs below 1×10^{-6} . For the average exposure scenario, all industrial exposure areas had ELCRs below 1×10^{-6} . External exposure to radiation was determined to be the dominant exposure pathway for both the residential and industrial exposure scenarios (HRA-3009, p 59).

For exposure to Rn-222 gas in indoor air, 21 of the 147 residential exposure areas had ELCRs greater than 1×10^{-4} , and the remaining 126 exposure areas had ELCRs between 1×10^{-6} and 1×10^{-4} for the RME scenario. For the average exposure scenario, 88 residential exposure areas had ELCRs between 1×10^{-4} and 1×10^{-6} , and 59 exposure areas had ELCRs below 1×10^{-6} . Of the 35 industrial exposure areas, 16 exposure areas had ELCRs between 1×10^{-6} and 1×10^{-4} , and 19 exposure areas had ELCRs below 1×10^{-6} for the RME scenario. For the average exposure scenario, two industrial exposure areas had ELCRs between 1×10^{-6} and 1×10^{-5} , and 33 industrial exposure areas had ELCRs below 1×10^{-6} . Inhalation of Rn-222 gas is the only exposure pathway for both the residential and industrial exposure scenarios (HRA-3009, p 61). Risks associated with Rn-222 gas are only relevant if buildings are constructed in the contaminated zone.

Most of the contaminated areas evaluated in this risk assessment lie along the shoreline and are slated for use as open space in San Francisco's reuse plan. The most likely receptor along the shoreline would be a recreational visitor rather than a resident or industrial worker. Receptors would not likely be exposed to the contaminated areas for 350 days per year (as assumed for residential exposure) or 250 days per year (as assumed for industrial exposure). Therefore, actual human exposure to radium in soil and radon gas in enclosed spaces and resulting health risks would be less than assumed in the radiation risk assessment, and are not considered significant. In addition, sources of Ra-226 are being further characterized as part of the Phase V Radiological Investigation, and the Navy will undertake actions to remove Ra-226 sources at Parcel E.

6.4.12.6 Phase IV Radiological Investigation

The Phase IV radiological investigation was begun in December 1998 to determine background concentrations of specific radionuclides and to further characterize areas of anomalous count rates that had been identified outside Buildings 364 and 707 during Phase III. Phase IV radiological investigation techniques and findings are summarized below (HRA-2993; HRA-3012).

6.4.12.6.1 Investigation Techniques

A total of 32 samples (16 concrete and asphalt and 16 soil samples) were collected behind Building 364. Of the 32 samples, 16 were considered background samples. Thirty-eight concrete and 38 soil samples were collected at the Building 707 concrete pad area. All samples were analyzed using gamma spectroscopy (HRA-3011).

6.4.12.6.2 Findings

Phase IV radiological investigation findings are summarized below.

- Samples collected from the Building 364 spill site and the Building 707 concrete pad contained concentrations of radionuclides distinguishable from background or that exceeded the revised site release criteria for Cs-137 of 0.13 pCi/g. The ATG removal action in 1996, with a release criterion of 2.4 pCi/g, had not removed sufficient material at Building 364 to meet current site-specific criteria (HRA-3011).
- The radionuclides of concern included Am-241, Co-60, europium-152 (Eu-152), europium-154 (Eu-154), K-40, Ra-226, Th-228, Th-232, and U-235, and Cs-137. Cs-137 was the only radionuclide of concern to exceed site-specific background criteria at the Building 707 concrete pad.

A CERCLA removal action was recommended at both the Building 364 spill site and the Building 707 concrete pad to reduce residual radioactive materials at these sites to levels consistent with a recommended preliminary remediation goal (PRG) of 0.13 pCi/g for Cs-137 (HRA-3011).

6.4.12.7 *Interim Investigations between Phase IV and Phase V*

Three interim investigations were conducted after the Phase IV radiological investigation. Available information for each investigation is summarized below.

6.4.12.7.1 1999 October IT Corporation Investigation

Sandblast waste was discovered and removed from an excavation site at IR-07. Five samples were collected and analyzed for radioactivity. Results were indicative of background concentrations (HRA-3004).

6.4.12.7.2 2001 TtEMI Investigation

In June and July 2001, TtEMI contracted a survey of the Gun Mole Pier (Regunning Pier) (HRA-3014). Gamma and beta measurements were obtained on the pier to determine whether elevated radioactivity levels remained from previous operations. The measurement points were based on a newly found drawing, indicating the previous location of the concrete test pad and NRDL barge on the pier (HRA-4719). Gamma levels were measured using a portable detection instrument equipped with a NaI scintillation probe. The measurements were made both in a systematic grid pattern and specifically over drains, surface cracks, and other unusual features.

Surface radioactivity at selected locations was also measured using a Geiger-Mueller detector sensitive to beta radiations.

Findings indicated that only background levels of radioactivity were present in the areas surveyed.

6.4.12.7.3 NWT Interim Investigation and Removal Action

During 2001, NWT performed a removal action at the tank vault behind Building 364. Others had removed the tanks, piping, and support equipment previously, and the remaining vault surfaces had been identified as exceeding site release criteria. The concrete vault was broken and removed using standard industrial demolition equipment, packaged, and shipped for disposal to a licensed disposal facility. Surveys and soil sampling performed following removal

of the concrete vault indicated that no residual contamination remained that exceeded site release criteria. The excavation was backfilled.

Additionally, a Characterization Survey of the Parcel E shoreline was performed. Gamma scans were conducted over pre-positioned grids using 2-by-2-inch NaI detectors and Ludlum Model 2360 Data Logger instruments. The shoreline survey encompassed areas within approximately 50 feet of the mean tide line with each grid assigned an individual identifier. The grid corners were identified using global positioning system coordinates. Several areas were noted during the survey that exceeded background gamma radiation levels, most significantly the area known as the “metal reef.” Samples obtained from those locations identified Ra-226 as the contaminant. The elevated reading locations were noted on survey maps. No removal actions were taken at the time of the survey.

6.4.12.8 Phase V Investigations

Beginning in January 2002, NWT conducted scoping and Characterization Surveys, soil and other media sampling programs, remediations, and Final Status Surveys at various areas and in various buildings at HPS in accordance with MARSSIM guidelines (HRA-2937). The investigations and surveys were in support of the release of buildings or areas that had been identified as areas where radioactive materials had been used or areas where remedial actions to remove known contamination had occurred.

The Phase V Investigations were conducted within a standard protocol that allowed for application of MARSSIM guidelines in the survey process. Each site was assessed for potential radionuclides of concern with surveys designed according to the MARSSIM area classification (Class 1, 2, or 3). In general, the surveys included gamma scans, gamma static readings, alpha/beta static readings, dose rate measurements, alpha/beta swipes, H-3 swipes (if appropriate), and sample analysis (alpha or gamma spectroscopy or beta analysis, as appropriate). The extent of the surveys depended upon the classification of the area. Class 1 surveys covered 100 percent of the area, Class 2 surveys covered 50 percent of the area, and Class 3 surveys covered 20 percent of the area. Static measurements were distributed accordingly.

If contamination was found in a Class 3 area, a 100 percent Characterization Survey was conducted followed by remediation as appropriate. A Class 1 Final Status Survey followed these actions. A synopsis of the results of the Phase V Investigation is provided in Table 6-6. Site-specific information for the Phase V Investigation is provided in Table 6-7. Site-specific information is provided in Section 8.0.

**TABLE 6-1
SITES IMPACTED BY G-RAM USE BY THE SHIPYARD**

Site	Purpose/Use
Building 113A	Gamma Radiography
Building 146	Gamma Radiography and Source Storage, Turn-In of Radium Devices, and Radioactive Waste Storage
Building 157	Radiography
Building 211	Welding Shop
Building 214	Gamma Radiography
Building 241	Shipyard Foundry
Building 253	Gamma Radiography, RADIAC Calibration, Radium Device Maintenance, and Possible Location of Radium Paint Shop
Building 271	Possible Radium Paint Shop
Building 272	Possible Radiography Shop
Building 351A	RADIAC Calibration, Radiography Shop, and Instrument Repair Facility
Building 366	Radium Device Maintenance and Boat/Plastics Shop
Building 383 Area	Turn-In Site for Radioluminescent Devices Removed from Ships
Building 408	Smelter – Disposal of Equipment with Radium Devices
Building 411	Gamma Radiography
Building 807	Scrap Yard Processing Shed
Building 813	Warehouse and Storage and Disaster Control Center
Building 819	Sanitary System Pump Station
Drydock 2	Equipped with Radioluminescent Devices, Removal of Radioluminescent Devices from Ships, and YAG Decontamination
Drydock 3	Equipped with Radioluminescent Devices and Removal of Radioluminescent Devices from Ships
Drydock 4	Equipped with Radioluminescent Devices and Removal of Radioluminescent Devices from Ships
Drydock 5	Removal of Radioluminescent Devices from Ships
Drydock 6	Removal of Radioluminescent Devices from Ships

TABLE 6-1
SITES IMPACTED BY G-RAM USE BY THE SHIPYARD

Site	Purpose/Use
Drydock 7	Removal of Radioluminescent Devices from Ships
Gun Mole Pier	Removal and Turn-In of Radioluminescent Devices
Parcel E Shoreline	Disposal of Radioluminescent Devices Mixed in with Other Waste and Material from Smelter, Incinerator, Foundry, and Burn Pits
IR-01/21	Landfill – Disposal of Radioluminescent Devices, NRDL Waste, Sandblast Media and Material from Smelter, Incinerator, Foundry and Burn Pits
IR-02	Bay Fill Area – Disposal of Radioluminescent Devices, NRDL Waste, Sandblast Media, and Material from Smelter, Incinerator, Foundry, and Burn Pits
IR-03	Oil Reclamation Ponds – Disposal of Radioluminescent Devices
IR-04	Scrap Yard – Disposal of Equipment with Radioluminescent Devices
IR-07	Potential Disposal of Radioluminescent Devices
IR-12	Salvage Yard – Disposal of Equipment with Radioluminescent Devices
IR-18	Potential Disposal of Radioluminescent Devices

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS ACHOMAWI ATF-148 FLEET OCEAN TUG	Support	01Sep46 PH	Own Power	SF Arrive 04Oct	06DecC46	13Dec46	Sold as scrap 22Mar86, Taiwan
USS AJAX AR-6 REPAIR SHIP	Support	28Aug46 PH	Own Power	SD	01Jan47	Unknown	Sold as scrap 23May97
USS ALBEMARLE AV-5 SEAPLANE TENDER	Support	30Jul46 PH	Own Power	LA	Unknown	22Nov46	Sold as scrap 17Jul75
USS ALLEN M. SUMNER DD-692 DESTROYER	Support	10Aug46 PH	Own Power	PS	19Nov46	10Jan47	Sold as scrap
USS ANDERSON DD-411 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 Bikini Atoll by Able Shot
APL-27 NON-SELF PROPELLED BARRACKS SHIP	Support	01Jul47	Towed	KA	25Feb47	10Mar46	MARAD transfer scrapped 1960
USS APOGON SS-308 SUBMARINE	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Atoll by Able Shot
USS APPALACHIAN AGC-1 AMPHIBIOUS FORCE FLAGSHIP	Support	29Jul46 PH	Own Power	SF Arrive 16Aug	02Oct46	03Oct46	Decontamination not required

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS APPLING APA-58 ATTACK TRANSPORT	Support	08Aug46 PH	Own Power	SF	22Nov46	13Dec46	Returned to National Defense Reserve Fleet 12Dec54; sold as scrap
ARD-29 NON-SELF-PROPELLED AUXILIARY FLOATING DRYDOCK	Support	16Sep46 PH	Towed	PH	18Feb47	18Feb47	Sold through SAP cash sale 01Mar77
ARDC-13 CONCRETE AUXILIARY FLOATING DRYDOCK	Target	N/A	N/A	N/A	N/A	N/A	Sunk 06Aug46 Bikini Atoll by Baker Shot
USS ARKANSAS BB-33 BATTLESHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Atoll by Baker Shot
USS ARTEMIS ATTACK CARGO SHIP	Support	18Aug46 PH	Own Power	SF Arrive Oct	20Nov46	27Dec46	Sold for scrap 1960s
ATA-124 AUXILIARY OCEAN TUG	Support	09Sep46 PH	Own Power Towed YF-385	PS	Unknown	18Dec46	Transferred SAA to Argentina 1947
ATA-180 AUXILIARY OCEAN TUG	Support	08Sep46 PH	Own Power – Towed YF-733	PS	24Feb47	Unknown	Unknown
ATA-185 AUXILIARY OCEAN TUG	Support	08Sep46PH	Own Power	SD	13Dec46	18Jan47	Sold for commercial service 1971
ATA-187 AUXILIARY OCEAN TUG	Support	11Sep46 PH	Own Power	SD	06Nov46	22Nov46	SAP transfer 01Feb75
ATA-192 AUXILIARY OCEAN TUG	Support	08Sep46 PH	Own Power	SF	14Nov46	10Feb47	Sale 15Apr76

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
ATR-40 RESCUE OCEAN TUG	Support	08Sep46 PH	Own Power – Towed UF-991	SF	17Dec46	21Dec46	Unknown
ATR-87 RESCUE OCEAN TUG	Support	08Sep46 PH	Own Power	PS	13Dec46	04Jan47	Unknown
USS AVERY ISLAND AG-76 MISCELLANEOUS SHIP	Support	07Aug46 SF	Own Power	SF Arrive 21Aug	03Dec46	04Jan47	Transferred to MARAD 04Jan60
USS BANNER APA-60 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 16Feb48 near KA
USS BARROW APA-61 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 11May48 near KA
USS BARTON DD-772 DESTROYER	Support	10Aug46 PH	Own Power	SF Arrive 29Aug	02Nov46	18Dec46	Sunk as target off Norfolk, VA, 8Oct69
USS BAYFIELD APA-33 ATTACK TRANSPORT	Support	08Aug46 SF	Own Power	SF/PS Arrive SF 20Aug	07Dec46	10Feb47	DRMO sale for scrap 15Sept69
USS BEGOR APD-127 HIGH-SPEED TRANSPORT	Support	03Aug46 PH	Own Power	SD	30Sep46	25Jan47	Sold as scrap 16Nov76
USS BENEVOLENCE AH-13 HOSPITAL SHIP	Support	25Aug46 PH	Own Power	SF	24Sep46	01Apr47	Sunk in collision off SF, 25Aug50

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS BEXAR APA-237 ATTACK TRANSPORT	Support	29Aug46 PH/SP	Own Power	SD/SF Arrive SF 02Nov	24Jan47	01Feb47	MARAD exchange 19Feb82
USS BLADEN APA-63 ATTACK TRANSPORT	Target	30Aug47 PH	Own Power	SF Arrive 13Sep OAK	06Nov46	21Dec46	Decommissioned 26Dec46 Norfolk, VA; transferred to U.S. Maritime Commission 03Aug53
USS BLUE RIDGE AGC-2 AMPHIBIOUS FORCE FLAGSHIP	Support	30Jul46 PH	Own Power	SF/LA Arrive SF 15Aug	Unknown	22Nov46	Sold for scrap 26Aug60
USS BOTTINEAU APA-235 ATTACK TRANSPORT	Support	10Aug46 PH	Own Power	SF Arrive 21Aug	19Dec46	27Dec46	MARAD exchange 01Aug83
USS BOUNTIFUL AH-9 HOSPITAL SHIP	Support	27Jul46 PH	Own Power	No Record	27Sep46	27Sep47	Decommissioned 13Sep46 Seattle, WA
USS BOWDITCH AGS-21 SURVEYING SHIP	Support	27Sep46 PH	Own Power	SF Arrive 19Oct	20Nov46	20Nov46	Transfer to MARAD 4Mar88
USS BRACKEN APA-64 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 10Mar48 off KA
USCG BRAMBLE WAGL-392	Support	24Aug46 KA	Own Power	PH	Unknown	22Nov46	USCG vessel; Decommissioned May 2003

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS BRISCOE APA-65 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 06May48 NEAR KA
USS BRULE APA-66 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 11May48 near KA
USS BURLESON APA-67 ATTACK TRANSPORT	Support	05Aug46 PH	Own Power	NV	Unknown	14Oct46	Reserve 9Nov46
USS BUTTE APA-68 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 12May48 near KA
USS CARLISLE APA-69 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 BA by Able Shot
USS CARTERET APA-70 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 19Apr48 in the Marshall Islands
USS CATRON APA-71 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 06May48 in the Marshall Islands
USS CEBU ARG-6 AMPHIBIOUS READY GROUP REPAIR SHIP	Support	23Aug46 PH	Own Power	PH/SF	16Dec46	21Dec46	Mothball Fleet Suisun Bay Final Disposition Unknown

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS CHARLES P. CECIL DD-835 DESTROYER	Support	28Jul46 PH	Own Power	Unknown	Unknown	22Nov46	SAP transfer 01Aug80
USS CHICKSAW ATF-83 FLEET OCEAN TUG	Support	07Sep46 GU	Own Power	SF Arrive 21Feb47	13Jan47	18Jan47	SAP transfer 01May76
USS CHIKASKIA AO-54 OILER	Support	24Aug46 PH – Towed APL-34	Own Power	SF Arrive 17Sep	31Dec46	04Jan47	Disposed of through SAP 01Aug80
USS CHOWANDOC ATF-100 FLEET OCEAN TUG	Support	16Sep46 PH – Towed ARD-29	Own Power	PH/SF Arrive SF 08Aug47	Unknown	01Feb47	Sold through SAP cash sale 01Oct77
USS CLAMP ARS-33 SALVAGE SHIP	Support	05Sep46 PH	Own Power	SF/LA Arrive SF 22Oct	Unknown	22Nov46	Transfer to MARAD 01Feb99
USS COASTERS HARBOR AG-74 SURVEY SHIP	Support	17Aug46 PH	Own Power	LA	07Dec46	13Dec46	Stricken 1Apr60; disposition unknown
USS CONSERVER ARS-39 SALVAGE SHIP	Support	01Feb47 PH	Own Power	PH	04May47	11May47	Sold through SAP cash sale 01Apr94
USS CONYNGHAM DD-371 DESTROYER	Target	23Aug46 PH	Own Power	SF Arrive 11Oct	Unknown	Unknown	Scuttled 26Jul48 off SO CA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS CORTLAND APA-75 ATTACK TRANSPORT	Target	30Aug47 PH	Own Power	SF Arrive 13Sep	06Nov46	16Dec46	Decommissioned 30Dec46 Norfolk, VA; Transferred to U.S. Maritime Commission 31Mar48; later sold as scrap
USS COUCAL ASR-8 SUBMARINE RESCUE VESSEL	Support	11Sep46 PH	Own Power – Towed SKIPJACK	SD	10Jan47	18Jan47	Target 19Jan91
USS CREON ARL-11 LANDING CRAFT REPAIR SHIP	Support	11Sep46	Own Power	LA	23Jan47	01Feb47	Decommissioned 8Jun49
USS CRITTENDEN APA-77 ATTACK TRANSPORT	Target	01Dec46 SF	Towed by USS CAHUILLA	SF Arrive Jan47	Unknown	Unknown	Sunk 5Oct48 off SO CA coast in 800 fathoms
USS CUMBERLAND SOUND AV-17 SEAPLANE TENDER	Support	01Aug46 SP	Own Power	LA	03Dec46	13Dec46	Sold 1Apr62
USS CURRENT ARS-22 SALVAGE SHIP	Support	02Dec46 PH 22Jul47 PH	Own Power	PH	06Feb47	17Feb47	DRMO scrap 01Sep74
USS DAWSON APA 79 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 19Apr48 near KA in 2,290 fathoms

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS DELIVER ARS-23 SALVAGE SHIP	Support	08Sep47 PH	Own Power – Towed LIME- STONE	SF Arrive 08Oct	20Dec46	27Dec46	Cash sale through SAP 01Aug79
USS DENTUDA SS-335 SUBMARINE	Target	28Aug46 PH	Own Power	SF/MI Arrive SF 14Oct	Unknown	Unknown	Decommissioned 11Dec46 at MI; used by 12th Naval District for training Naval reservists; sold for scrap 20Jan69
USS DIXIE AD-14 DESTROYER TENDER	Support	28Aug46P H	Own Power	SF Arrive 22Sep	02Oct46	22Nov46	Disposed of by MARAD 17Feb83
USS DUTTON AGS-8 SURVEYING SHIP	Support	25Sep46	Own Power	LA	18Dec46	10Jan47	Sold 21Feb50
USS ENOREE AO-69 OILER	Support	07Sep46 PH	Own Power – Towed APL-30	SF Arrive 04Oct	03Dec46	Unknown	Transfer to MARAD 1Feb59
USS ETLAH AN-79 NET LAYING SHIP	Support	02Sep46	Own Power	PS	18Dec46	21Dec46	Decommissioned 31May60
USS FALL RIVER CA-131 HEAVY CRUISER (FLAGSHIP)	Support	09Sep46 PH	Own Power	LA	23Dec46	27Dec46	Sold 28Aug72; Scrapped
USS FALLON APA-81 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 10Mar48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS FILLMORE APA-83 ATTACK TRANSPORT	Target	28Aug46P H	Own Power	SF Arrive 05Nov	22Nov46	04Jan47	Decommissioned 24Jan47 Norfolk, VA; transferred to U.S. Maritime Commission 01Apr48
USS FLUSSER DD-368 DESTROYER	Support	09Sep46 PH	Own Power	PH	22Nov46	13Dec46	Sold 6Jan48
USS FULTON AS-11 SUBMARINE TENDER	Support	Unknown	Unknown	SF Arrive MI 18Sep	24Dec46	10Jan47	DRMO sale scrap 12Nov95
USS FURSE DD-882 DESTROYER	Support	Unknown	Unknown	LA	Unknown	22Nov46	SAP cash sale 31Aug72
USS GASCONADE APA-85 ATTACK TRANSPORT	Target	Unknown	Towed to SF	SF Arrive 27Jan47	N/A	N/A	Sunk 21Jul48 off SO CA in 1,300 fathoms
USS GENEVA APA-86 ATTACK TRANSPORT	Target	13Oct46 PH	Own Power	SF Arrive 04Nov	Unknown	04Jan47	Decommissioned 01Jan47 Norfolk, VA; transferred to U.S. Maritime Commission 02Apr48; transferred to NC reserve fleet Jul55; scrapped 02Nov66
USS GEORGE CLYMER APA-27 ATTACK TRANSPORT	Support	20Aug46 PH	Own Power	SD	22Nov46	07Feb47	Decommissioned 31Oct67

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS GILLIAM APA-57 ATTACK TRANSPORT	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 BA by Able Shot
USS GUNSTON HALL LSD-5 DOCK LANDING SHIP	Support	02Sep46 PH	Own Power	LA	08Jan47	10Jan47	SAP transfer 01May70
USS GYPSY ARSD-1 SALVAGE LIFTING SHIP	Support	10Sep46 PH	Own Power	PH/LA	09Jan47	19Jan47	DRMO Scrap Sale 01Jan74
USS HAVEN AH-12 HOSPITAL SHIP	Support	10Oct46 PH	Own Power	SF/LA Arrive SF 23Oct	14Feb47	Unknown	Transferred to MARAD 05Jun67
USS HENRICO APA-45 ATTACK TRANSPORT	Support	16Aug46 PH	Own Power	SF Arrive 29Aug	28Jan47	01Feb47	Decommissioned 14Feb68
USS HESPERIA AKS-13 GENERAL STORES ISSUE SHIP	Support	31Aug46 PH	Own Power	PH/SF Arrive SF 23Dec	28Dec46	04Jan47	MARAD sale 01Oct79
USS HUGHES DD-410 DESTROYER	Target	Unknown	Towed	PS/SF Arrive SF Post Dec46	Unknown	Unknown	Sunk as Target 16Oct48 off WA
USS INDEPENDENCE CVL-22 SMALL AIRCRAFT CARRIER	Target	Unknown	Towed	SF Arrive 16Jun47	Unknown	Unknown	Sunk as Target 26Jan51 off SF in 1,000 fathoms

**TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION**

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS INGRAHAM DD-694 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF/PS Arrive 04Sep	19Nov46	21Nov46	Decommissioned 16JUL71
USS JAMES M. GILLISS AGS-13 SURVEYING SHIP	Support	20Aug46 PH	Own Power	SF Arrive 30Sep	13Nov46	13Nov46	Sold 17Jun60
USS JOHN BLISH AGS-10 SURVEYING SHIP	Support	20Aug46 PH	Own Power	SF Arrive 06Oct	15Oct46	22Nov46	Decommissioned 26AUG49; scrapped
USS KENNETH WHITING AV-14 SEAPLANE TENDER	Support	14Aug46 PH	Own Power	LA/SF Arrive Oakland 25Aug	11Dec46	21Dec46	Decommissioned 30Sep58
USS LAFFEY DD-724 DESTROYER	Support	10Aug46 PH	Own Power	SF ENT ARD-32 prior to 04Sep	02Nov46	18Dec46	Donated as museum and memorial 15Aug78
USS LAMSON DD-367 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 01Jul46 BA
LCI-327 LANDING CRAFT INFANTRY SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 30Oct47 near KA
LCI-329 LANDING CRAFT INFANTRY SHIP	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 16Mar48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
LCI-332 LANDING CRAFT INFANTRY SHIP	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 30Sep47 near KA
LCI-620 LANDING CRAFT INFANTRY SHIP		N/A	N/A	N/A	N/A	N/A	Sunk 10Aug46 off BA
LCI(I)-549 LARGE INFANTRY LANDING CRAFT	Target	Unknown	Own Power	SF Arrive Jun48	04Apr47	01Aug48	Towed to Port Chicago, CA, Jan49; sold Learner Company of Alameda 02Aug49
LCI(L)-615 LARGE INFANTRY LANDING CRAFT	Target	Unknown	Own Power	SF Arrive Jun48	30Jun47	17Aug48	Sold 19Aug49 to private party
LCI(L)-1062 LARGE INFANTRY LANDING CRAFT	Support	Unknown	Own Power	GU/PH	Unknown	04Jan47	Unknown
LCI(L)-1067 LARGE INFANTRY LANDING CRAFT	Support	09Sep46 GU	Own Power	GU	24Feb47	Unknown	Unknown
LCI(L)-1091 LARGE INFANTRY LANDING CRAFT	Support	09Sep46 GU	Own Power	GU	Unknown	11Dec46 EST.	Sold 1961. Flagship USS LCI National Association, privately owned.
USS LIMESTONE IX-158 CONCRETE BARGE	KWAJALEIN ONLY	08Sep46	Towed BY USS DELIVER	N/A	Unknown	22Nov	Unknown

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS LOWRY DD-770 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF Arrive 29Aug	06Nov46	04Jan47	SAP transfer 01Oct73
LSM-60 MEDIUM LANDING SHIP	Target – Suspended Shot Baker	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 BA
USS LST-52 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk by Gunfire Apr48 near KA in 2,280 fathoms
USS LST-125 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 14Aug46 near BA
USS LST-133 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 11May48 near KA
USS LST-220 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 12May48 near KA
USS LST-388 TANK LANDING SHIP	Support	Unknown	Own Power	SF Arrive 14Oct	05Dec46	13Dec46	Disposed of by MARAD 7April48
USS LST-545 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 12May48 near KA
USS LST-661 TANK LANDING SHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul48 near KA
USS LST-817 TANK LANDING SHIP	Support	31Aug46 PH	Own Power	SF Arrive PT HUE 09Oct	21Nov46	22Nov46	Sold for scrap 25May48
USS LST-861 TANK LANDING SHIP	Support	02Sep46 PH	Own Power	SF Arrive 02Oct	06Dec46	13Dec46	Sold for scrap 10Jun48

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS LST-871 TANK LANDING SHIP	Support (did not enter BA)	09Aug46 SF	Own Power	SF	N/A	22Nov46	DECON not required
USS LST-881 TANK LANDING SHIP	Support	31Aug46 PH	Own Power	SF Arrive 02Oct ENT HP BY 01Nov	13Dec46	23Dec46	Sold for scrap 24Nov47
USS LST-989 TANK LANDING SHIP	Support	09Aug46 PH	Own Power	SF Arrive 30Aug	19Nov46	22Nov46	Sold for scrap 25Jun48
USS MayRANT DD-402 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 04Apr48 near KA
USS MENDER ARSD-2 SALVAGE LIFTING SHIP	Support	04Sep46 PH	Own Power – Towed YW and LCT-1078	LA	03Jan47	Unknown	DRMO scrap sale 01Jan74
USS MOALE DD-693 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF Arrive 04Sep	19Nov46	11Dec46 (PS)	DRMO scrap sale 01Dec74
USS MOUNT MCKINLEY AGC-7 AMPHIBIOUS FORCE FLAGSHIP	Support	10Aug46 PH	Own Power	SD/SF Arrive SF 26Aug	20Dec46	29Jan47	MARAD transfer 22Sept77
USS MUGFORD DD-389 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 22Mar48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS MUNSEE ATF-107 SERVED AS OCEAN TUG	Support	02Sep46PH	Own Power	SF	18Nov46	01Apr47	Unknown
USS MUSTIN DD-413 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 28Apr48 near KA
NAGATO JAPANESE BATTLESHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 30Jul46 Bikini Lagoon
USS NEVADA BB-36 BATTLESHIP	Target	Unknown	Towed	PH	Unknown	Unknown	Sunk 31Jul48 off Pearl Harbor
USS NEWMAN K. PERRY DD-883 DESTROYER	Support	04Aug46 PH/SD	Own Power	SD/SF Arrive SF 04Sep	17Jan47	25Jan47	SAP transfer 01Feb81
USS NEW YORK BB-34 BATTLESHIP	Target	Unknown	Towed	PH	Unknown	Unknown	Sunk 08Jul48 southwest of Pearl Harbor
USS NIAGARA APA-87 ATTACK TRANSPORT	Target	Unknown	Unknown	SF/KA Arrive SF 15Sep	06Nov46	10Nov46	ARR Norfolk, VA, 23Nov46; used to test explosive in Chesapeake Bay 1947-48; sold as scrap 05Feb50 to Northern Metals Company of Philadelphia
USS O'BRIEN DD-725 DESTROYER	Support	08Aug46 PH/SD	Own Power	SF Arrive 29Aug	06Nov46	19Dec46	Disposed of as target 01Dec72

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS ONEOTA AN-85 NET LAYING SHIP	Support	06Sep46 GU	Own Power	PH	11Dec46	Unknown	Unknown
USS ORCA AVP-49 SMALL SEAPLANE TENDER	Support	Unknown	Own Power	PH/SF Arrive SF 26Oct	11Dec46	13Dec46	SAP transfer January 1962
USS OTTAWA AKA-101 ATTACK CARGO SHIP	Support	02Aug46 PT HUE	Own Power	SF/PH Arrive SF 05Sep	13Sep46	13Sep46	14Mar47, disposition unknown
USS PALMYRA ARS(T)-3 SALVAGE CRAFT TENDER	Support	Unknown	Own Power	SF	22Nov46	04Jan47	Stricken 1 June73
USS PANAMINT AGC-13 AMPHIBIOUS FORCE FLAGSHIP	Support	Unknown	Own Power	SF/LA Arrive SF 12Aug	22Nov46	22Nov46	Decontamination not required
USS PARCHE SS-384 SUBMARINE	Target	28Aug46 PH/SF	Own Power	SF by 11Dec MI RPTD 14Oct	Unknown	11Dec46	Towed to Naval Reserve docks in Oakland Feb48; used as Naval Reserve training ship; sold for scrap Jul70
USS PENNSYLVANIA BB-38 BATTLESHIP	Target	N/A	N/A	N/A	N/A	N/A	Sunk 10Feb48 near KA

**TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION**

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS PENSACOLA CA-24 HEAVY CRUISER	Target	21Apr47PS	Towed BY USS HITCHITI	KA/PS	Unknown	Unknown	Sunk 10Nov48 off coast of WA in 1,400 fathoms
PGM-23 PATROL MOTOR GUNBOAT	Support	09Sep46PH	Own Power	PH	Unknown	Unknown	Decommissioned 1947
PGM-24 PATROL MOTOR GUNBOAT	Support	09Sep46 PH	Own Power	PH	13Feb47	13Mar47	Unknown
PGM-25 PATROL MOTOR GUNBOAT	Support	12Aug46G U	Own Power	NO	Unknown	28May47	Transferred to Republic of China 1946
PGM-29 PATROL MOTOR GUNBOAT	Support	12Aug46 GU	Own Power	NO	Unknown	28May47	Sold to Greece 11Dec47
PGM-31 PATROL MOTOR GUNBOAT	Support	12Aug46 GU	Own Power	PH/SF Arrive SF 30Jan47	17Jan47	25Jan47	Transferred to Republic of China March 1954
PGM-32 PATROL MOTOR GUNBOAT	Support	12Aug46 GU	Own Power	RP	Unknown	10Oct46	Unknown
USS PHAON ARB-3 BASE REPAIR SHIP	Support	03Sep46 PH	Own Power	LA	26Dec46	04Jan47	Sold 8Jul62
USS PILOTFISH SS-386 SUBMARINE	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Lagoon

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS POLLUX AKS-4 STORES ISSUE SHIP	Support	20Aug46 PH	Own Power	PS/SF Arrive SF 11Sep	29Nov46	25Jan47	Stricken 01Jan69; disposition unknown
USS PRESERVER ARS-8 SALVAGE SHIP	Support	01Sep46 PH	Own Power	LA	08Dec46	04Jan47	Assigned to Naval Reserve training facility
USS PRESQUE ISLE APB-44 SELF-PROPELLED BARRACKS SHIP	Support	02Sep46 PH	Own Power	LA/SF Arrive SF 29Sep	12Dec46	21Dec46	Stricken 1May59; disposition unknown
PRINZ EUGEN GERMAN CRUISER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 22Dec46 KA
USS QUARTZ IX-150 CONCRETE BARGE	Support	03Sep46 PH	Towed by OUX	PS	12Dec46	13Dec46	Sold to the Powell River Company 23Oct47. Scrapped as breakwater.
USS RALPH TALBOT DD-390 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 22Mar48 near KA
USS RHIND DD-404 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 22Mar48 KA
USS ROBERT K. HUNTINGTON DD-781 DESTROYER	Support	10Aug46 PH	Own Power	PS	19Nov46	04Jan47	SAP transfer 01Oct73

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS ROCKBRIDGE APA-228 ATTACK TRANSPORT	Support	29Aug46	Own Power	SF Arrive 12Sep	06Dec46	13Dec46	Sold for scrap 27May69
USS ROCKINGHAM APA-229 ATTACK TRANSPORT	Support	29Aug46 PH	Own Power	SF Arrive 12Sep	04Dec46	18Dec46	Disposed of by MARAD 2Oct79
USS ROCKWALL APA-230 ATTACK TRANSPORT	Support	19Aug46 PH/SP	Own Power	SF Arrive 10Sep	17Dec46	27Dec46	MARAD transfer 1Aug83
USS ROLETTE AKA-99 ATTACK CARGO SHIP	Support	30Aug46 PT HUE	Own Power	SD	28Jan47	01Feb47	MARAD transfer 1Jul60
USS SAIDOR CVE-117 ESCORT AIRCRAFT CARRIER	Support	04Aug46 PH	Own Power	SD	28Jan47	01Feb47	Sold for scrap 22Oct71
USS SAINT CROIX APA-231 ATTACK TRANSPORT	Support	02Aug46 PH to SD to SF	Own Power	SD/SF Arrive SF 17Aug	22Nov46	10Jan47	MARAD transfer 15Nov79
SAKAWA JAPANESE LIGHT CRUISER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 02Jul46 Bikini Lagoon
USS SALT LAKE CITY CA-25 HEAVY CRUISER	Target	PH	Towed to PS by TAKELMA and HITCHITI	PS	Unknown	Unknown	Sunk by torpedoes 25May48 off San Clemente, CA, in 2,000 fathoms

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS SAN MARCOS LSD-25 DOCK LANDING SHIP	Support	Unknown	Own Power	SF Arrive 02Oct	24Oct47	18Jan47	SAP transfer 01Aug74
USS SARATOGA CV-3 AIRCRAFT CARRIER	Target	N/A	N/A	N/A	N/A	N/A	Sunk 25Jul46 Bikini Lagoon
USS SEARAVEN SS-196 SUBMARINE	Target	Unknown	Unknown	SF (MI) Arrive SF 22Oct	Unknown	11Dec46	Sunk 11Sep48 off SO CA
USS SEVERN AO-61 OILER	Support	Unknown	Own Power	LA	Unknown	03Nov46	MARAD sale 22Jan79
USS SHAKAMAXON AN-88 NET LAYING SHIP	Support	06Sep46 GU	Own Power	PH	12Dec46	04Jan47	MARAD sale 16Sep77
USS SHANGRI-LA CV-38 AIRCRAFT CARRIER	Support	28Jul46 PH	Own Power	Unknown	Unknown	22Nov46	Scrapped 1988
USS SIOUX ATF-75 FLEET OCEAN TUG	Support	03Sep46 PH	Own Power	LA	23Nov46	04Dec46	SAP sale 01Aug73
USS SKATE SS-305 SUBMARINE	Target	28Aug46SF	Towed by FULTON to PH; Towed by CLAMP to SF	SF (MI) Arrive SF 22Oct	Unknown	Unknown	Decommissioned 11Dec46; scuttled 04Oct48 off San Diego coast in 515 fathoms

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS SKIPJACK SS-184 SUBMARINE	Target	11Sep46PH	Towed by COUCAL and USS PALMYRA	SF (MI) Arrive SF Oct	Unknown	Unknown	Sunk as target 11Aug48 off SO CA in 700 fathoms
USS SPHINX ARL-24 LANDING CRAFT REPAIR SHIP	Support	14Dec46 WAKE ISLAND	Own Power	LA	14Feb47	23Apr47	Transfer to MARAD 02Jul90
USS STACK DD-406 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk by gunfire 24Apr48 off KA
USS SUNCOCK AN-80 NET LAYING SHIP	Support	02Sep46 PH	Own Power – Towed ETLAH	PS	12Dec46	13Dec46	DRMO scrap 28Jul71
USS SYLVANIA AKA-44 ATTACK CARGO SHIP	Support	27Aug46 PH	Own Power	PS/SF Arrive SF 21Sep	07Dec46 Seattle	Unknown	MARAD transfer 1Feb47; scrapped 1964
USS TELAMON ARB-8 BASE REPAIR SHIP	Support	15Aug46	Own Power – Towed LCT-1359	LA/SF Arrive SF 07Sep	12Dec46	21Dec46	DRMO sale 01Mar74
USS TOMBIGBEE AOG-11 GASOLINE TANKER	Support	05Sep46 PH	Own Power	LA	31Dec46	04Jan47	SAP transfer 7Jul72
USS TRIPPE DD-403 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk as target 03Feb48 near KA

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS TUNA SS-203 SUBMARINE	Target	28Aug46 PH	Own Power	SF Arrive 14Oct	Unknown	Unknown	Departed MI 20Sep48; scuttled 24Sep48 off SO CAL in 1,160 fathoms
USS TURNER DD-834 DESTROYER	Support	25Jul46 PH	Own Power	Unknown	Unknown	22Nov46	Not contaminated – did not enter Bikini Lagoon after Baker
USS WAINWRIGHT DD-419 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Sunk as target 05Jul48 near KA
USS WALKE DD-723 DESTROYER	Support	10Aug46 PH/SD	Own Power	SF Arrive 25 Aug	Unknown	23Oct46	DRMO scrap sale 01Mar75
USS WENATCHEE ATF-118 FLEET OCEAN TUG	Support	28Aug46 PH	Own Power	SF/LA Arrive 01Oct	13Nov46	13Nov46	SAP transfer date unknown
USS WHARTON AP-7 TRANSPORT SHIP	Support	28Aug46 SF	Own Power	PS/SF Arrive SF 07Sep	10Feb47 Seattle	Unknown	Stricken 26Mar47
USS WIDGEON ASR-1 SUBMARINE RECUS VESSEL	Support	11Sep46 PH	Own Power	SF Arrive 12Nov	13Dec46	10Jan47	Sold as scrap 1948
USS WILDCAT AW-2 WATER DISTILLING SHIP	Support	28Aug46 PH	Own Power	PS	09Jan47	10Jan47	Sold as scrap, mid-1970s

TABLE 6-2
OPERATION CROSSROADS SHIPS DECONTAMINATION AND DISPOSITION

Ship	Function	Return Date/To	Method	DECON	OP Clear	Final Clear	Comments/ Final Disposition
USS WILSON DD-408 DESTROYER	Target	N/A	N/A	N/A	N/A	N/A	Scuttled 08Mar48 near KA
YMS-354 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Sold to South Korea
YMS-358 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Sold to South Korea
YMS-413 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Unknown
YMS-463 MINESWEEPER	Support	21Oct46 GU	Own Power	GU	20Dec46	10Feb47	Unknown

**TABLE 6-3A
APRIL 1947 CLIMATE CONDITIONS**

April	Wind Speed (mph)		From Direction	
Day	Average	Maximum	Average	Precipitation
1	13	26	276	0.00
2	11	23	213	0.10
3	20	30	288	0.00
4	18	30	290	0.00
5	13	22	265	0.03
6	12	21	244	0.00
7	11	24	254	0.00
8	12	24	266	0.08
9	17	28	289	0.00
10	12	22	236	0.00
11	7	14	191	0.00
12	8	23	153	0.00
13	5	16	135	0.00
14	8	18	192	0.00
15	14	30	287	0.00
16	17	26	291	0.00
17	23	30	275	0.00
18	7	22	178	0.00
19	14	28	246	0.00
20	20	38	282	0.00
21	10	28	197	0.00
22	7	22	211	0.00
23	11	21	297	0.00
24	8	17	250	0.00
25	10	20	279	0.00
26	7	18	186	0.00
27	10	18	264	0.00
28	7	15	280	0.00
29	11	22	293	0.00
30	8	20	213	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

**TABLE 6-3B
MAY 1947 CLIMATE CONDITIONS**

May	Wind Speed (mph)		From Direction	
Day	Average	Maximum	Average	Precipitation
1	7	20	190	0.00
2	14	26	297	0.00
3	18	26	291	0.00
4	16	22	294	0.00
5	11	17	269	0.00
6	9	22	187	0.00
7	9	20	216	0.00
8	20	30	282	0.00
9	20	38	291	0.00
10	19	28	299	0.00
11	10	24	190	0.00
12	11	20	272	0.00
13	11	24	269	0.00
14	9	25	172	0.00
15	9	20	209	0.00
16	13	30	251	0.00
17	15	24	287	0.00
18	10	22	246	0.00
19	13	22	293	0.00
20	12	20	310	0.00
21	12	25	267	0.00
22	7	36	145	0.00
23	9	17	220	0.00
24	12	24	267	0.00
25	9	18	203	0.00
26	12	20	195	0.32
27	12	18	253	0.02
28	15	25	287	0.00
29	11	20	273	0.00
30	11	18	230	0.00
31	10	18	202	0.32

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

**TABLE 6-3C
JUNE 1947 CLIMATE CONDITIONS**

June	Wind Speed (mph)		From Direction	
Day	Average	Maximum	Average	Precipitation
1	11	26	210	0.02
2	11	18	257	0.00
3	11	18	256	0.00
4	6	16	173	0.20
5	9	20	185	0.08
6	5	15	123	0.28
7	11	30	192	0.08
8	10	17	211	0.05
9	20	30	284	0.00
10	20	31	282	0.00
11	18	30	291	0.00
12	14	25	223	0.00
13	17	28	296	0.00
14	12	24	262	0.00
15	9	17	222	0.00
16	10	26	252	0.00
17	14	28	288	0.00
18	11	24	246	0.00
19	15	32	280	0.00
20	18	33	282	0.00
21	19	26	322	0.00
22	10	20	223	0.00
23	16	26	304	0.00
24	13	22	302	0.00
25	10	22	252	0.00
26	14	24	256	0.00
27	20	30	272	0.00
28	13	24	250	0.00
29	10	20	196	0.00
30	14	24	272	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

**TABLE 6-3D
JULY 1947 CLIMATE CONDITIONS**

July	Wind Speed (mph)		From Direction	
Day	Average	Maximum	Average	Precipitation
1	15	28	271	0.00
2	19	30	272	0.00
3	23	35	273	0.00
4	18	33	276	0.00
5	17	30	270	0.00
6	18	28	270	0.00
7	16	26	269	0.00
8	16	28	271	0.00
9	20	30	270	0.00
10	18	26	272	0.00
11	19	28	271	0.00
12	17	26	272	0.00
13	17	28	274	0.00
14	21	30	273	0.00
15	19	30	271	0.00
16	14	24	255	0.00
17	16	28	276	0.00
18	17	30	291	0.00
19	15	30	292	0.00
20	14	26	285	0.00
21	17	28	272	0.00
22	16	25	272	0.00
23	24	39	283	0.00
24	23	36	284	0.00
25	17	25	281	0.00
26	9	20	231	0.00
27	9	20	214	0.00
28	14	25	275	0.00
29	15	28	271	0.00
30	22	32	270	0.00
31	22	30	272	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

**TABLE 6-3E
AUGUST 1947 CLIMATE CONDITIONS**

August	Wind Speed (mph)		From Direction	
Day	Average	Maximum	Average	Precipitation
1	17	26	271	0.00
2	14	28	268	0.00
3	13	22	281	0.00
4	10	25	235	0.00
5	16	30	305	0.00
6	16	26	276	0.00
7	17	32	271	0.00
8	16	28	285	0.00
9	17	26	285	0.00
10	10	20	229	0.00
11	11	18	240	0.00
12	11	25	239	0.00
13	13	24	274	0.00
14	13	22	291	0.00
15	10	22	272	0.00
16	11	25	272	0.00
17	12	24	295	0.00
18	12	23	303	0.00
19	10	23	250	0.00
20	16	26	232	0.00
21	24	35	272	0.00
22	15	26	253	0.00
23	11	22	294	0.00
24	12	21	256	0.00
25	14	18	270	0.00
26	10	18	243	0.00
27	8	18	237	0.00
28	8	20	196	0.00
29	9	20	212	0.00
30	12	25	289	0.00
31	9	22	223	0.00

Source: Weather Station '023272 - San Francisco' 4.6 Miles Northwest of Shipyard.

The National Climatic Data Center (NCDC), Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data and Information Service (NESDIS).

**TABLE 6-4
SITES IMPACTED BY RETURN OF SHIPS
FROM OPERATION CROSSROADS**

Site	Purpose/Use
Building 103	Personnel Change House and Decontamination Center
Building 203	Fuel Oil Burning
Building 224	Sample/Material Storage
Building 253	Storage of Parts and Equipment Removed from Ships
Building 317	Stores/Animal Quarters
Building 503	Contaminated Laundry Facility
Building 506	Administrative and Laboratory
Building 507	Decontamination Center
Building 521	Fuel Oil Burning
Drydock 2	Ship Decontamination and Contaminated Equipment Removal
Drydock 3	Ship Decontamination and Contaminated Equipment Removal
Drydock 4	Ship Decontamination and Contaminated Equipment Removal
Drydock 5	Ship Decontamination and Contaminated Equipment Removal
Drydock 6	Ship Decontamination and Contaminated Equipment Removal
Drydock 7	Ship Decontamination and Contaminated Equipment Removal
Former NRDL Site on Mahan Street	Potential Storage Site for Contaminated Equipment
Gun Mole Pier	Contaminated Equipment Removal, Berthing of ex-INDEPENDENCE
IR-01/21	Potential disposal of ship decontamination wastes
IR-02	Potential disposal of ship decontamination wastes
IR-07	Potential disposal of ship decontamination wastes
IR-18	Potential disposal of ship decontamination wastes
Parcel F/Bay Waters	Discharged Material from Ship Decontamination
Ships' Berths	Ship Decontamination and Contaminated Equipment Removal

TABLE 6-5A
SITES IMPACTED BY NRDL USE OF G-RAM THROUGH 1955

Area	Purpose/Use
Building 103	Personnel Change House and Decontamination Center
Building 113	Sample Storage from Atomic Weapons Tests
Building 114 Site	Design Branch and Technical Library
Building 142	Sample Storage and Low Background Counting Laboratory
Building 214	Health Physics Counting Room
Building 224	Atomic Test Sample Storage
Building 274	Decontamination Training
Building 313 Site	Instrumentation Laboratory
Building 313A	RADIAC Development, Instrumentation Laboratory, Laboratory Offices, and Training
Building 317 Site	Temporary Animal Quarters
Building 322 Site	Instrumentation Laboratory (Parcel D)
Building 322 in Parcel A	Original building moved from Parcel D to Parcel A in 1959. No direct NRDL use in Parcel A.
Building 351	Electronics Work Area, Sampling Laboratory, Research Laboratory, and Biological Research Laboratory
Building 351A	Instrumentation Calibration Facility and Chemical Technology Division
Building 364	Hot Cell, General Research Laboratory, and Research Animal Facility
Building 365	Animal Research Facility and Personnel Decontamination Storage
Building 366 (351B)	Administration and Stock Issue Section, General Laboratories, Instrument Calibration, and Chemical Research
Building 406	Receipt and Shipping of NRDL Materials
Building 500	NRDL Offices
Building 503 Site	Small Animal Exposure Facility and Radioactive Laundry Facility
Building 506 Site	Main Laboratory, Chemistry Laboratory, Nuclear Laboratory, Animal Experimentation, Radiochemistry Laboratory, Radioactive Waste Storage Tank, and Radioisotope Storage
Building 507 Site	Nucleonics Division, Animal Colony, Biological-Medical Laboratory, and Radioactive Laundry
Building 508 Site	Administration and Medical Services, Health Physics Division, and Project Offices
Building 509 Site	Annex A and Animal Irradiation Studies
Building 510 Site	Radiation Facility, Glass Blowing Shop, Sample Storage, Nucleonics Laboratory, and Physics Laboratory
Building 510A Site	X-Ray Facility, Thermal Research Facility, and Sample Storage
Building 517	Biological-Medical Laboratory, Cobalt Irradiation Facility, and Animal Exposure Facility
Building 520	Administration, Thermal Radiation Division, and Project Offices
Building 529	Underground Isotope Storage Vault and Radiation Experimentation
Building 701 Site	Sample Storage
Building 704 Radioactive Materials Storage Site	Radioactive Materials Storage Area

TABLE 6-5A
SITES IMPACTED BY NRDL USE OF G-RAM THROUGH 1955

Area	Purpose/Use
Building 704 Animal Pens Site	Large Animal Research Colony
Building 707 and Kennels	Research Animal Colony
Building 707B	Animal Colony
Building 707C	Animal Colony
Building 707 Waste Triangle	Temporary Animal Pens and Receipt, Packaging and Storage of Radioactive Waste
Building 708	Research Animal Facility, Animal Psychology Study Colony, and Biological Research Laboratory
Building 816	Two-meV Van de Graaff Generator and Chemical-Biological Laboratory
Site S-719	Incinerator; Possibly Used for Animal Disposal from Building 707
Experimental Shielding Range	Ship Shielding Studies
Gun Mole Pier	Radioactive Pavement Decontamination Study, Contaminated B-17 Aircraft Studies, Studies on ex-INDEPENDENCE, Portable Laboratory, Contamination Studies, Experimental Barge YFN-809, Decontamination and Laboratory Facility (YFNX-16), and Loading of Radioactive Waste Barge for Ocean Disposal
Shack 79 Site	Equipment Storage
Shack 80 Site	Equipment Storage

TABLE 6-5B
SITES IMPACTED BY NRDL USE OF G-RAM AFTER 1955

Area	Purpose/Use
Building 113A	Storage of Lead Sheet from Building 364
Building 364	Animal Irradiation Facility, Liquid Radioactive Waste Collection Facility, Engineering Test Equipment Storage, and Sample Storage
Building 365	Animal Research Facility and Personnel Decontamination Storage
Building 506 Site	Low Power Neutron Generator, Low Flux Neutron Laboratory, Chemistry Laboratory, Tritium Target Storage
Building 510 Site	Sample Storage and Physics Laboratory
Building 510A Site	Thermal Research Facility and Kevatron Facility
Building 517	Cobalt-60 Irradiation Facility and Animal Exposure Facility
Building 529	Neutron Generator, Low Flux Neutron Laboratory, and Cockroft-Walton Accelerator
Building 707 and Kennels	Research Animal Colony
Building 707 Waste Triangle	Temporary Animal Pens and Receipt, Packaging and Storage of Radioactive Waste
Building 708	Research Animal Facility, Animal Psychology Study Colony, and Biological Research Laboratory
Building 815	Consolidated Research Facility
Building 816	Van de Graaff Particle Generator
Building 820	Cyclotron Laboratory and Neutron Radiation Facility
Building 821	One-meV X-Ray Facility and X-Ray Laboratory
Building 830	Research Animal Breeding Facilities and Kennels
Building 831	Research Animal Breeding Facilities and Kennels
Experimental Shielding Range	Ship Shielding Studies
S-719	Incinerator; Possibly Used for Animal Disposal
Gun Mole Pier	Radioactive Pavement Decontamination Study, Contamination Studies, Experimental Barge YFN-809, Decontamination and Laboratory Facility (YFNX-16), and Loading of Radioactive Waste Barge for Ocean Disposal
ICW 418	Warehouse Storage

**TABLE 6-6
PHASE V ACTION SUMMARY**

Parcel/Area	Action Taken
A/Building 821	Class 3 surveys performed. Slightly elevated levels found in drains. Class 1 surveys performed. No contamination found. Final status survey report submitted and finalized.
B/ Building 103	Class 3 surveys complete. Slightly elevated levels of Cs-137 found under building investigated and found to be below action levels. Final status survey report submitted to RASO.
B/Building 113 IR-42	Class 3 surveys complete. Gamma spectroscopy of concrete, firebrick, and hand kiln samples indicated NORM that did not exceed action levels. Firebricks and hand kiln disposed of. Final status survey report submitted to RASO.
B/Building 113A	Class 3 surveys complete. Thirteen elevated gamma scan locations investigated. NORM below background found. Final status survey report submitted to RASO.
B/Building 130 IR-24	Class 3 surveys complete. Eleven elevated gamma scan locations investigated. NORM below investigation level found and attributed to gravel. Final status survey report submitted to RASO.
B/Building 146 IR-23	Class 3 surveys complete. Twelve elevated gamma scan locations investigated. NORM below action level found. Historical research identified need for Class 1 survey. Report of actions completed submitted to RASO.
B/Drydock 6	Class 3 surveys complete. Ra-226 identified in samples within background range. Final status survey report submitted to RASO.
B/Drydock 6 Sediment	Sediment samples taken from the bottom centerline of drydock at 100-foot intervals along length of the drydock for gamma spectroscopy. Two of these samples were also processed by alpha spectroscopy. No contamination found. Results incorporated into Drydock 6 final status survey report
C/Building 211	Formerly used for storage of LLRW by NWT. Class 1 and 2 surveys complete. Elevated levels found in area not used for LLRW storage. Report of actions completed submitted to RASO.
C/Building 214 IR-28	Class 3 surveys complete. No elevated levels found. Final status survey report submitted to RASO.
C/Building 224 IR-28	Class 3 surveys complete. Final status survey report submitted to RASO.
C/Building 241	Class 3 surveys complete. Elevated areas found. Firebrick and potassium nitrate removed. Class 1 and 2 surveys complete. No elevated levels found. Final status survey report submitted to RASO.
C/Building 253	Class 3 surveys complete on first through sixth floors. Contamination found and remediated on fifth and sixth floor. Class 1 survey conducted on fifth and sixth floors and roof with additional surveys found contamination throughout building, ventilation shafts, piping, manholes, and on ledge outside of building. Roof and parts of ventilation system remediated. Report of actions completed submitted to RASO.
C/Building 271	Class 3 survey complete. Radium contamination found. Characterization, remediation, and Class 1 complete. Final status survey report submitted to RASO.
C/Building 272	Class 3 survey complete. No contamination found. Final status survey report submitted to RASO.

**TABLE 6-6
PHASE V ACTION SUMMARY**

Parcel/Area	Action Taken
C/Drydock 2	Seven radium devices found and removed. Class 1 and Class 2 surveys completed of areas with devices. Final status survey report submitted to RASO.
C/Drydock 3	Class 3 surveys complete. Eleven devices removed; 3 were Ra-226. Class 1 and Class 2 surveys completed of areas with devices. Final status survey report submitted to RASO.
C/Drydock 4	Class 3 surveys complete. Eleven devices removed; 1 was Ra-226. Class 1 and Class 2 surveys completed of areas with devices. Final status survey report submitted to RASO.
D/Building 274 IR-35	Class 3 surveys complete. Investigated seven elevated gamma scan readings. Identified NORM that did not exceed action levels. Final status survey report submitted to RASO.
D/Building 313 Site IR-35	Class 3 surveys complete. Cs-137 contamination above action level found and remediated. Class 1 surveys complete. Final status survey report submitted to RASO.
D/Building 313A Site IR-35	Class 3 surveys complete. Cs-137 and Eu-152 contamination slightly above action levels found and remediated. Contaminated manhole found (see D/Building 313A Site Manhole). Class 1 survey complete. Final status survey report submitted to RASO.
D/Building 313A Site Manhole	Discovered during remediation of Building 313A site. Manhole no longer connected to any system. Water and sediment removed from manhole. Initial surveys and sampling found elevated readings in sediment and manhole. Sediment removed from manhole. Manhole removed. Class 1 surveys complete. Results incorporated into Building 313A Site report.
D/Building 322 Site	Class 3 surveys complete. Found Cs-137 and Eu-152 slightly above action levels. Characterization, remediation, and Class 1 survey complete. Final status survey submitted to RASO.
D/Building 351 IR-34	Class 3 surveys complete. Second Class 3 surveys conducted as original background area (Building 411) determined to be impacted site. No contamination found. Final status survey report submitted to RASO.
D/Area Behind Building 351 between Buildings 323 and 324 IR-34	Class 3 surveys complete. Elevated Cs-137 found. Characterization and remediation complete. Class 1 surveys and review of data complete. Final status survey report submitted to RASO.
D/Building 351A IR-34	Class 3 surveys complete. Contamination identified in crawlspace. See below. Final status survey report submitted to RASO.
D/Building 351A Crawlspace	Contaminated pipe and soil removed and disposed. Class 1 surveys completed. NWT data review complete. Final status survey report submitted to RASO.
D/Building 364 IR-33	Continuation from prior interim project. Contamination found and remediated. Class 1 survey completed found elevated alpha and beta readings in Room 107 that require remediation. Results provided in report to RASO.
D/Building 364 Crawlspace	Continuation from prior interim project. Contaminated found and remediated. Class 1 survey completed. Final status survey report submitted to RASO.

**TABLE 6-6
PHASE V ACTION SUMMARY**

Parcel/Area	Action Taken
D/Area behind Buildings 351A and 364	Continuation from prior interim project. Characterization complete. Cs-137 contamination found and remediated. Investigated void space found at former Building 317 site and found no contamination. Class 1 survey identified additional area of contamination just outside of back steps from Building 351A. Results reported to RASO in Building 351A report.
D/Building 364 Trench	Continuation from prior interim project. Cs-137 contamination found. Additional pipe removed and disposed. Class 1 survey found additional elevated levels. Remediation and surveys complete. Results to be incorporated into Building 364 report.
D/Manhole Between Building 364/365	Cs-137 contamination found when tracing pipes from Building 364. Scraped and disposed of loose sediment. Elevated levels remain. Manhole sampled. Characterization indicates elevated levels in some manholes and lines. Results to be incorporated into report on sanitary and storm drain systems.
D/Manhole and Sewer Line on Cochrane Street	Manhole surveyed. Contamination found and removed. Sewer lines surveyed. Elevated levels found in lines and manholes. Results to be incorporated into report on sanitary and storm drain systems.
D/Building 365 IR-33	Class 3 surveys complete. No elevated readings found. Final status survey report submitted to RASO.
D/Building 366 (Former Building 351B)	Class 1 surveys complete. Identified contamination in ventilation system and floor drains. Results provided in report to RASO.
D/Building 383	Class 3 surveys complete. No elevated readings found. Safe found containing night vision device with thoriated lens that is being used by San Francisco Police Department. Final status survey report submitted to RASO.
D/Building 411	Class 3 surveys complete. Slightly elevated radium levels found on second floor in two areas. Elevated radium levels investigated and found to be within release limits. Final status survey report submitted to RASO.
D/Gun Mole Pier with Berths 15, 16, 17, 18, 19, and 20	Class 3 surveys complete. Elevated readings found on GMP. Sediment had elevated levels of Cs-137. Remediated areas on GMP-B. Class 1 surveys of remediated areas complete. Final status survey report for selected areas submitted to RASO.
D/Former NRDL Site on Mahan Street	Class 3 surveys complete. Elevated levels of Cs-137 and Ra-226 found. Characterization complete. Elevated readings found. New map located indicating much larger area. Additional characterization complete and reviewed by RASO. Remediation complete. Class 1 surveys complete. Final status survey report provided to RASO.
E/Building 406	Class 3 surveys complete. Elevated levels of Ra-226 found. Characterization and remediation complete. Class 1 surveys complete. Required recounts completed. One area remains to be remediated where a source had leaked onto the wood framing. Results provided in report to RASO.
E/Building 414	Class 3 surveys complete. Included areas under gravel. No elevated levels found. Final status survey report submitted to RASO.
E/Building 506 Site IR-14	Class 3 survey of building footprint complete. No elevated levels found. Historical research indicates need for Class 1 survey of building footprint, and former underground waste tank location outside of building. Results provided in report to RASO.

**TABLE 6-6
PHASE V ACTION SUMMARY**

Parcel/Area	Action Taken
E/Building 507 Site IR-38	Class 3 survey of building footprint complete. Elevated levels of radium found and remediated. Class 1 surveys of remediated area complete. Historical evidence indicates need for additional Class 1 surveys outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 508 Site IR-38	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 surveys of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 509 Site IR-38	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 510/510A Site IR-14	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 517 Site IR-70	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site and areas outside/adjacent to building footprint. Results provided in report to RASO.
E/Building 520 Site IR-14	Class 3 survey of building footprint complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of building footprint. Results provided in report to RASO.
E/Building 529 Site IR-14	Class 3 survey of building footprint complete. Historical evidence indicates need for investigation of underground isotope storage facility and Class 1 survey of building footprint. Results provided in report to RASO.
E/Area around Buildings 506, 520 and 529 Sites	Class 3 survey complete. Elevated levels found near foundation of Building 520. Investigation of elevated levels found sand with radium contamination and piping system with cesium contamination. Results provided in report to RASO.
E/Building 701 Site	Class 3 surveys complete. No elevated levels found. Results provided to RASO.
E/Building 707 IR-39	Asbestos removal complete. Surveys complete. Results provided to RASO.
E/Building 707 Concrete Pad	Remediated 3 areas previously. Area mowed and debris removed. Surveys complete. Recounts conducted. Elevated cesium-137 levels found underneath concrete pad. Results provided to RASO.
E/Building 707 Triangle	Area mowed and debris removed. Grids complete. Innovative Technology Solutions, Inc.'s removal of soil from IR-01/21 complete. Surveys complete. Results provided to RASO.
E/Building 707 Drains	Mobilization complete. Started tracing lines. Obstructed lines prohibit surveys internal characterization surveys. Samples show piping to be contaminated. Results provided to RASO.
E/Building 708	Mobilization complete. Asbestos contractor work complete. Surveys complete. No contamination found. Results provided to RASO.
E/Building 810	Class 3 surveys complete. No elevated levels found inside of building. Class 1 survey required as a result of finding contamination on loading dock. Results provided to RASO.
E/Shack 79 Site	Class 3 surveys complete. No elevated levels found. Historical evidence indicates need for Class 1 survey of site. Results provided to RASO.

TABLE 6-6
PHASE V ACTION SUMMARY

Parcel/Area	Action Taken
E/Shack 80 Site	Class 3 surveys complete. Elevated levels of Cs-137 found. Characterization and remediation complete. Class 1 and 2 surveys complete; located additional areas of cesium contamination. Results provided to RASO.
E/IR-01/21 (includes South Gate Range)	Area mowed and gridded. Surveys and sampling complete. Elevated areas identified. Results provided to RASO.
E/IR-04	Surveys complete on original boundary of site. Site boundaries expanded due to elevated readings at original boundary. Contamination found in railroad track areas. Results provided to RASO.

TABLE 6-7
RADIOLOGICAL SITE INVESTIGATION SUMMARY

Building No. or Area	Other Investigations										Preliminary Assessment	Phase II Interim Investigations							Post-Phase IV Interim Investigation 1999- 2000			Remedial Investigations				
	1946 and 1947 SDAT Surveys	1955 NRDL Surveys	1969 NRDL Survey for Disestablishment	1969 to 1970 AEC Surveys	1974 HPS Survey for Base Closure	April 1978 LFE Survey of Building 815	July 1978 RASO Survey of Building 815	September 1978 RASO Surveys of Other NRDL Buildings	1979 RASO Resurvey of Buildings 364, 815, and 816	1986 EPA NNPP Operations Investigation	1988 HLA Site Reconnaissance	1993 PRC H-3 Study	1993 CDHS H-3 Study	1993 EPA Study of Parcel E Soil	1994 EPA Petrographic Study of Parcel B	1994 Drydock 4 Surveys	1996 ATG Building 364 Peanut Spill Remediation	IDW Investigation	1999 October IT Corporation Investigation	2001 TrEMI Investigation	Phase I Radiological Investigation	Phase II I Radiological Investigation	Phase III Radiological Investigation	Phase IV Radiological Investigation	2002 NWT Phase V Radiological Investigation	
Parcel A																										
813																										
816			✓	✓				✓	✓			✓	✓								✓					
819																										
821				✓																					✓	
Parcel B																										
103																									✓	
113																									✓	
113A					✓			✓																	✓	
114 Site																										
130																									✓	
140 and Discharge Channel																										
142																										
146			✓																							
157																										
Drydock 5																										
Drydock 6	✓																								✓	
Drydock 7																										
Submarine Base Area (IR-07)											✓				✓				✓		✓	✓				
Waste Oil Disposal Area (IR-18)															✓					✓	✓					
Parcel C																										
203																										
205 and Discharge Tunnel																										
211																									✓	
214					✓																				✓	
224																									✓	

TABLE 6-7
RADIOLOGICAL SITE INVESTIGATION SUMMARY

Building No. or Area	Other Investigations										Preliminary Assessment		Phase II Interim Investigations						Post-Phase IV Interim Investigation 1999- 2000		Remedial Investigations				
	1946 and 1947 SDAT Surveys	1955 NRDL Surveys	1969 NRDL Survey for Disestablishment	1969 to 1970 AEC Surveys	1974 HPS Survey for Base Closure	April 1978 LFE Survey of Building 815	July 1978 RASO Survey of Building 815	September 1978 RASO Surveys of Other NRDL Buildings	1979 RASO Resurvey of Buildings 364, 815, and 816	1986 EPA NNPP Operations Investigation	1988 HLA Site Reconnaissance	1993 PRC H-3 Study	1993 CDHS H-3 Study	1993 EPA Study of Parcel E Soil	1994 EPA Petrographic Study of Parcel B	1994 Drydock 4 Surveys	1996 ATG Building 364 Peanut Spill Remediation	IDW Investigation	1999 October IT Corporation Investigation	2001 TTEM Investigation	Phase I Radiological Investigation	Phase II I Radiological Investigation	Phase III Radiological Investigation	Phase IV Radiological Investigation	2002 NWT Phase V Radiological Investigation
Parcel C (Continued)																									
241																									✓
253					✓																				✓
271																									✓
272																									✓
Dry Dock 2										✓															✓
Dry Dock 3	✓									✓															✓
Dry Dock 4	✓									✓						✓					✓				✓
Parcel D																									
274																						✓			✓
313		✓																							✓
313A		✓																							✓
317																									✓
322		✓																							✓
351		✓																							✓
351A		✓			✓																				✓
364			✓	✓				✓	✓											✓			✓		✓
365				✓				✓																	✓
366		✓																							✓
383																									✓
408																									
411																									✓
Gun Mole Pier																				✓					✓
500																									
503 Site																									
Mahan Street-NRDL																									✓

TABLE 6-7
RADIOLOGICAL SITE INVESTIGATION SUMMARY

Building No. or Area	Other Investigations										Preliminary Assessment	Phase II Interim Investigations							Post-Phase IV Interim Investigation 1999- 2000		Remedial Investigations					
	1946 and 1947 SDAT Surveys	1955 NRDL Surveys	1969 NRDL Survey for Disestablishment	1969 to 1970 AEC Surveys	1974 HPS Survey for Base Closure	April 1978 LFE Survey of Building 815	July 1978 RASO Survey of Building 815	September 1978 RASO Surveys of Other NRDL Buildings	1979 RASO Resurvey of Buildings 364, 815, and 816	1986 EPA NNPP Operations Investigation		1988 HLA Site Reconnaissance	1993 PRC H-3 Study	1993 CDHS H-3 Study	1993 EPA Study of Parcel E Soil	1994 EPA Petrographic Study of Parcel B	1994 Drydock 4 Surveys	1996 ATG Building 364 Peanut Spill Remediation	IDW Investigation	1999 October IT Corporation Investigation	2001 TtEMI Investigation	Phase I Radiological Investigation	Phase II IRadioloigcal Investigation	Phase III Radiological Investigation	Phase IV Radiological Investigation	2002 NWT Phase V Radiological Investigation
Parcel E																										
406																										✓
414																										✓
500																										
506			✓	✓				✓																✓		✓
507		✓																						✓		✓
508		✓																						✓		✓
509																								✓		✓
510		✓																						✓		✓
510A																								✓		✓
517				✓				✓																✓		✓
520																										✓
521																										
529			✓	✓				✓																✓		✓
701																					✓					✓
704 RAM Area																										
704 Animal Pens																										
707				✓				✓																		✓
707B																										✓
707C																										
707 Triangle Area				✓																						✓
708																										✓
719																										
807																										
810																		✓								✓
Shack 79																										✓
Shack 80																										✓
Experimental Shielding Range																										✓

TABLE 6-7 RADIOLOGICAL SITE INVESTIGATION SUMMARY																									
Building No. or Area	Other Investigations										Preliminary Assessment	Phase II Interim Investigations							Post-Phase IV Interim Investigation 1999- 2000		Remedial Investigations				
	1946 and 1947 SDAT Surveys	1955 NRDL Surveys	1969 NRDL Survey for Disestablishment	1969 to 1970 AEC Surveys	1974 HPS Survey for Base Closure	April 1978 LFE Survey of Building 815	July 1978 RASO Survey of Building 815	September 1978 RASO Surveys of Other NRDL Buildings	1979 RASO Resurvey of Buildings 364, 815, and 816	1986 EPA NNPP Operations Investigation		1988 HLA Site Reconnaissance	1993 PRC H-3 Study	1993 CDHS H-3 Study	1993 EPA Study of Parcel E Soil	1994 EPA Petrographic Study of Parcel B	1994 Drydock 4 Surveys	1996 ATG Building 364 Peanut Spill Remediation	IDW Investigation	1999 October IT Corporation Investigation	2001 THEM1 Investigation	Phase I Radiological Investigation	Phase II 1Radiological Investigation	Phase III Radiological Investigation	Phase IV Radiological Investigation
Parcel E (Continued)																									
Industrial Landfill (IR-01/21)											✓										✓	✓			✓
Bay Fill (IR-02)											✓			✓							✓	✓			
IR-03																									
IR-04																									✓
Salvage Yard																									
Shoreline																									✓
Parcel F																									
Underwater Areas										✓															
Ships 'Berths																									✓
Base Wide																									
Storm Drain Lines																						✓			✓
Sanitary Sewers																						✓			✓
Septic Systems/ Drain Fields																									✓
Off-Base Sites																									
ICW-418				✓																					
FUDS																									
815			✓	✓		✓	✓		✓																
820				✓																					
830																									
831																									

7.0 ASSESSMENT OF IMPACTED SITES

This section describes the methods and definitions used in Section 8.0 to categorize and assess the likelihood of residual contamination at impacted sites, the contaminated media involved, the potential for migration of contamination, and the recommended actions for each impacted site. Evaluations and definitions are based on guidance provided in MARSSIM.

Impacted sites were assessed based on the site's operational history and whether G-RAM was used, stored, or potentially disposed of at the site. Previous site surveys, studies, and investigations, when available, were also used to confirm or expand on the historical information.

Most of the historical radiological surveys and investigations at HPS were conducted prior to the publication of MARSSIM in December 1996; therefore, the terminology used in this section will not necessarily apply to historical documents. However, the Phase V Radiological Investigations that were conducted from January 2002 through June 2003 were conducted following MARSSIM guidelines. The protocols used for these surveys are described below and will be considered for future actions.

7.1 IMPACTED SITES

An impacted site is one that has a potential for radioactive contamination based on historical information or is known to contain radioactive contamination. Areas immediately adjacent to the primary impacted site may be included in this designation. Impacted sites include:

- Sites where radioactive materials were used or stored
- Sites where known spills, discharges, or other unusual occurrences involving radioactive materials have occurred, or may have occurred, that could have resulted in the release or spread of contamination
- Sites where radioactive materials might have been disposed of or buried

7.2 NON-IMPACTED SITES

A non-impacted site is one, based on historical documentation or results of previous radiological survey information, with no reasonable possibility for residual radioactive contamination.

7.3 IMPACTED SITE ASSESSMENTS

Assessments for each impacted site are provided in Section 8.0. These are based on the historical information and site surveys conducted prior to June 30, 2003. The assessments cover both media and migration pathways. These assessments may change in the future as the result of the implementation of recommended actions or location of additional historical information. The system used to assess the potential radiological contamination at an impacted site is detailed below.

7.3.1 Contamination Potential

The potential for residual radioactive contamination at each impacted site has been determined through a professional evaluation of historical information, previous survey results, and site reconnaissance. As recommended actions continue in the future, these assessments will change. Contamination potentials are categorized as:

- **Known-Restricted Access:** Radioactive contamination is known to exist at levels that could require protective clothing, respiratory protection, radiation monitoring, and site access controls
- **Known-Continued Access:** Low levels of contamination exist, but the contamination is contained in a system, fixed on building surfaces, or is in generally inaccessible areas
- **Likely:** Residual radioactive contamination is expected but has not been confirmed
- **Unlikely:** Residual radioactive contamination is not expected but investigation is warranted
- **Unknown:** Residual radioactive contamination potentially exists but no clear indication of possible contamination levels or contaminants has been established
- **None:** Radioactive contamination has been fully assessed and removed, if necessary, and the site has been free-released by the Navy and regulators. The site remains classified as impacted but no further action is required.

7.3.2 Contaminated Media

Section 8.0 also categorizes and assesses different types of media at each impacted site that contain, or are suspected of containing, radioactive contamination. Previous survey data, historical information, and professional judgment were used to confirm the presence of contamination or determine contamination potential. Generic terms, as defined in MARSSIM, are used to categorize the types of material that would contain the contamination. For example, if a building contains radioactive contamination in concrete floor materials, the medium would be defined as “structures.” To ensure that all potential media contamination has been evaluated, Section 8.0 includes an assessment for all media categories for each impacted site. The definitions for the types of media that could be contaminated are provided below.

- **Surface Soil:** The top layer of soil (to 6 inches bgs), fill, gravel, waste piles, concrete, or asphalt that is available for direct exposure, growing plants, resuspension of particles for inhalation, and mixing from human disturbances. This definition includes surface sediment in underwater areas.
- **Subsurface Soil:** Solid materials and media found below the surface soils.
- **Sediment:** Material that settles to the bottom of a liquid or is deposited by water.
- **Surface Water:** Waters found in streams, rivers, lakes, and oceans as well as coastal tidal waters.
- **Groundwater:** Waters contained in subsurface materials and aquifers.
- **Air:** Atmosphere that becomes a migration pathway for resuspension and dispersal of radioactive contamination and contaminated media.
- **Structures:** A man-made surface(s) above the surface or contained within subsurface media.
- **Drainage Systems:** Sanitary drains, facility storm drains, or septic systems and leach fields and sediments contained therein. This category can include Bay sediments where drainage to the Bay occurs.

7.3.3 Contaminated Media Assessment

Section 8.0 provides an assessment of each contaminated media category at each impacted site. These ratings are determined during the evaluation of each media type. The ratings may change if additional historical information becomes available or further information is developed during the performance of surveys at the site. Ratings are defined below.

- **High:** Evidence of contamination in the media or migration pathway has been identified.
- **Moderate:** The potential for contamination in the media or migration pathway exists, although the extent has not been fully assessed.
- **Low:** The potential for contamination in the type of media or migration pathway is remote.
- **None:** Evidence of contamination in the specific media or migration pathway has not been found, or known contamination has been removed, and surveys indicate that the media or migration pathway meet today's release criteria.

7.3.4 Potential Migration Pathways

Migration pathways are the media or transport mechanisms that allow contamination to spread in the immediate vicinity of the contaminated media or off site. The assessment of each impacted site in Section 8.0 provides an evaluation of the potential migration of radioactive contamination. The type of potential or confirmed contaminated media and the radionuclides of concern were used to assess the potential migration pathways.

7.4 RECOMMENDED ACTIONS

A recommended action for each impacted site is also provided in Section 8.0. The recommendation is the result of the summary investigations conducted to determine radionuclides of concern, contamination potential, contaminated media, and potential migration pathways for exposure. The categories of recommended actions are defined below.

- **Emergency Action:** Immediate remediation or containment is required because the levels of radioactive contamination or radiation exposure are such that there is a high potential for significant exposure or release of radioactive materials to the public or the environment.
- **Scoping Survey:** Historical documentation indicates that radioactive materials may be present at an impacted site that has not had an initial evaluation previously performed, and a survey is required to determine if contamination exists. The intent of these surveys is to identify radionuclide contaminants, relative radionuclide ratios, and general levels and extent of contamination. These surveys usually include minimal surface scans, sampling, and dose rate assessments.

- **Characterization Survey:** Radioactive contamination has been confirmed within an impacted site by a scoping survey, and action must be taken to determine the extent of the contamination and to identify and define the extent of the radionuclides of concern. These surveys include facility or site in-depth surveys, sampling, monitoring, and analysis to provide the basis for acquiring necessary technical information to develop, analyze, and select appropriate cleanup techniques.
- **Remediation:** Radioactive contamination has been fully characterized within an impacted site, and remedial or removal action is necessary to comply with site-specific release criteria. Remedial action support surveys are performed while remediation is being conducted to guide the cleanup activities.
- **Final Status Survey:** Historical documentation and previous investigations or remediations indicate that radioactive contamination has been removed from an impacted site, and a survey needs to be conducted in accordance with MARSSIM guidelines to verify that an impacted site complies with applicable site release criteria. This survey includes the appropriate measurements and sampling that will define the radiological condition of a site in preparation for release. The surveys follow completion of decontamination or remediation activities, if any were performed, but can also be conducted to confirm that past radiological activities at an impacted site did not result in residual contamination.
- **Free Release:** Historical documentation and previous investigations and surveys indicate that all applicable release criteria have been met, and the site documentation is ready for review by the Navy and applicable regulators for future non-radiological usage. This may include confirmatory surveys by Navy or regulatory personnel to verify the results reported in the release documentation.
- **No Further Action:** An impacted site has been shown by the Navy and applicable regulatory agencies to meet release criteria.

7.5 MARSSIM SURVEY CLASSIFICATIONS

MARSSIM classifies surveys for impacted sites as Class 1, 2, or 3, depending on the potential for residual contamination. The classification is used to ensure that areas with higher potential for contamination receive a higher degree of survey effort with areas with the greatest potential for contamination receiving Class 1 surveys. The survey classification impacts Final Status Surveys and is instrumental in assessing free release documentation.

The survey classifications will be applied to recommended actions in Section 8.0, where appropriate. As surveys progress and data are analyzed, areas may be reclassified based on newly acquired survey data. For example, if contamination is found during a Class 3 survey, a

more extensive Class 1 survey would typically be conducted. The three survey classifications are summarized below. Detailed descriptions are provided in Section 4.3.5.

7.5.1 Class 1 Surveys

Class 1 surveys are recommended for an impacted site that has a high potential for radioactive contamination, is known to have contamination, or had a prior remediation to remove radioactive contamination. This includes areas with contamination in excess of release limits based on a scoping or Characterization Survey or areas where previous Class 2 or 3 surveys found contamination above the release limits. Class 1 surveys cover 100 percent of the site.

7.5.2 Class 2 Surveys

Class 2 surveys are recommended for an impacted site that has a potential for radioactive contamination but the contamination is not expected to exceed the release limit. This includes areas known to contain minor isolated areas of contamination with low potential for exposure, buffer zones around Class 1 areas, or areas where previous Class 3 surveys found contamination. Class 2 surveys can cover 10 to 100 percent of the site.

7.5.3 Class 3 Surveys

Class 3 surveys are recommended for an impacted site that is not expected to contain residual contamination exceeding the release limit. This includes buffer zones around Class 1 or 2 areas or previously decontaminated and surveyed areas. The percentage of the site covered by Class 3 surveys is not standardized, and surveys may be conducted randomly.

7.6 PHASE V RADIOLOGICAL INVESTIGATION PROTOCOL

The Phase V Radiological Investigations were conducted within a standard protocol that applied MARSSIM guidelines during the survey process. Each site was assessed for potential radionuclides of concern using gamma scans, gamma static readings, alpha/beta static readings, dose rate measurements, alpha/beta swipes, tritium swipes (if appropriate), and sample analysis (alpha or gamma spectroscopy, or beta analysis, as appropriate). Extent of survey coverage included 100 percent for Class 1 surveys, 50 percent for Class 2 surveys, and 20 percent for Class 3 surveys. Static and dose rate measurements as well as swipe and samples were

distributed accordingly within the percentage of the area surveyed. If contamination was found during a Class 3 survey, a 100 percent Characterization Survey was conducted followed by remediation, remedial action support surveys, and a Class 1 Final Status Survey. Site-specific information for the Phase V Investigation is provided in Table 6-7, and general information is provided in Section 8.0.

Due to contract realignment, the Phase V Radiological Investigations were suspended in June 2003. The recommendations for future action in Section 8.0 take into account the level of effort that was completed up to that point. The results of the Phase V investigations will be published in separate site-specific reports.

7.7 IMPACTED SITE EXAMPLE

A building, formerly used as a research laboratory, is identified as impacted. Undefined contamination has been found on interior building surfaces during a Class 3 scoping survey.

Contamination Potential: Known-Continued Access. The contamination has been confirmed but there is no indication of hazardous levels.

Potentially Contaminated Media

Surface Soil – Low: There is a slight likelihood that contamination from the building could be in the surface soils immediately surrounding the building.

Subsurface Soil – Low: There is a very slight likelihood that contamination from the surface soils could be in subsurface soils. Depending on the information available at the time of rating and professional evaluation of the information, this potential could be identified as “None.”

Sediment – None: There is not sediment associated with the building.

Surface Water – None: There is no surface water near the laboratory.

Groundwater – None: As the contamination is in the interior of the building, there is no potential for groundwater contamination.

Air – None: Contamination found in the building surfaces is insufficient to cause concern for airborne contamination. This rating would be based on the type and level of radioactivity identified in the contamination.

Structures – High: Contamination has been identified in the building.

Drainage Systems – High: With surface contamination on the building interior surfaces, there is a significant potential that the drainage systems (primarily sanitary) would be contaminated, as most laboratory rooms contain sink drains.

Migration Pathways for Exposure to the Public or Environment

Surface Soil – Low: The potential contamination in the surface soils would present a low probability for exposure to the public or off-site environment, as there is no probable transport mechanism to cause detectable levels of contamination to spread to off-site locations.

Subsurface Soil – None: There is limited means of initially contaminating subsurface soils; therefore, an exposure to the public or off-site environment is not likely.

Surface Water – None: The information on potentially contaminated media already established that there were no surface waters in the vicinity of the building. Contamination in the interior of a building would require transport of the contamination to surface waters by a secondary method such as runoff to a storm drain system, which is not likely to occur.

Air – None: Low levels of interior building surface contamination would require transport of a significant portion of the contamination outside the confines of the building, and then a secondary mechanism to carry the contamination off site.

Structures – Low to Moderate: Migration of the contamination in the building is likely. However, the potential for contamination to migrate to the public would be dependent on the access and security controls for the building.

Drainage Systems – Low: With contamination on interior building surfaces, the building drainage sanitary system may be contaminated. Low levels in drainage systems would be diluted by flow of non-contaminated liquids from other sources. The exposure potential from this contamination is minimal.

Recommended Actions: Characterization Survey.

8.0 FINDINGS AND RECOMMENDATIONS

This section describes the buildings, structures, and open areas at HPS that are designated as “impacted” by radiological operations.

8.1 IMPACTED VERSUS NON-IMPACTED SITES

The scope of radiological operations at HPS has been assessed to determine whether these operations had a direct or indirect effect on buildings, structures, or open areas. These evaluations were based on guidance provided in MARSSIM to define all sites as either “impacted” or “non-impacted” by radiological operations. Impacted sites are those where radiological operations occurred, including the use, handling, packaging, or disposal of radioactive materials.

A summary of the former and current uses of impacted sites is provided in Table 8-1. A summary of the assessments and recommendations for the impacted sites is provided in Table 8-2.

8.2 SITE ASSESSMENTS

This section provides complete descriptions for each impacted site, including the former and current uses, radionuclides of concern, and previous radiological investigations of the site. This section also categorizes and defines the likelihood of residual contamination at impacted sites, the contaminated media involved, the potential for migration of G-RAM, and the recommended actions for each impacted site using the categories described in Section 7.0.

Table 8-2 provides a summary of potential contamination and migration pathway assessments and recommendations for all impacted sites detailed in Section 8.3.

8.3 PARCEL SUMMARY

HPS has been divided into six parcels: A, B, C, D, E, and F. Each of these parcels represents an area of the shipyard that has been delineated for future commercial, residential, or recreational purposes. Proposed future uses of each parcel are detailed in Figure 3-3. While

individual sites in a parcel currently may be leased to private parties, a parcel is not transferred from the Navy until all requirements for unrestricted release of the property have been met. In general, the impacted sites lie within the defined parcel boundaries. There are, however, buildings identified outside of current Navy property or in areas that cross parcel boundaries. Details of impacted sites are provided in Sections 8.3.1 through 8.3.6 and in Tables 8-1 and 8-2.

8.3.1 Parcel A Impacted Sites

8.3.1.1 Building 816



Site Description: Originally was a windowless, two-story concrete structure completed in December 1953 (HRA-1051, p 1 of 3). Building wing to the right in the photograph was added from 1956 to 1957 and houses the neutron pit. The upper floor housed the Van de Graaff accelerator and its associated mechanical/electrical equipment. The ground floor was devoted to a laboratory, machine shop, and control room (HRA-2113, p 7). One of the unique features of the building is a 4-foot-thick, 30-ton door at the south end. A steel addition was constructed to perform low intensity proton experiments (HRA-177). Figure 8.3.1.1 provides a site plan, and Figure 8.3.1.1FP provides a floor plan of the building in 1954.

Former Uses: Two-Megaelectron volt (MeV) Van de Graaff Neutron Generator, chemical-biological laboratory, offices, and machine shop (HRA-2113, p 7).

Current Uses: Unoccupied.

Radionuclides of Concern: H-3.

Previous Radiological Investigations:

- 2001 NWT H-3 survey. No activity detected.
- 1993 CDHS H-3 survey. Confirmed PRC results. EPA concurrence with results.
- 1993 PRC H-3 study. Samples obtained from outside building areas. No result exceeded the MDA value of 0.5 pCi/gm.
- 1992 PRC Phase I gamma walkover survey. No anomalies noted.
- 1979 NRC confirmatory survey. Area met criteria for the period.
- 1979 RASO H-3 survey. Building meets Regulatory Guide 1.86 limits.
- 1978 RASO survey. No activity detected.
- 1969 Final AEC clearance given 24 November 1969.

Contamination Potential: Unlikely.

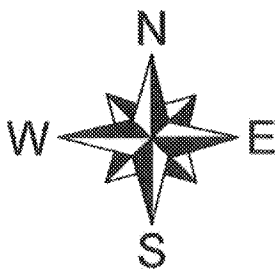
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

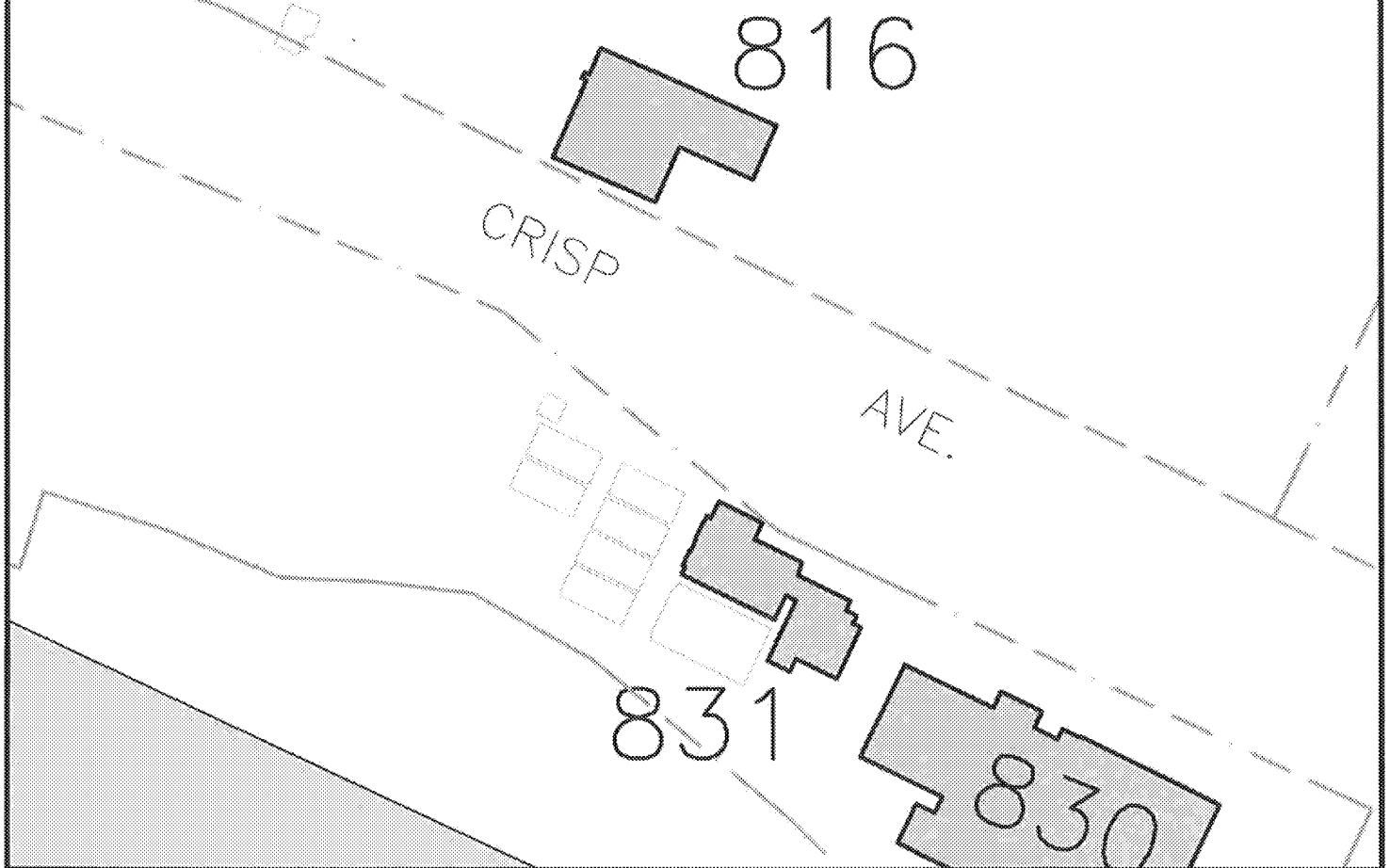
Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: No Further Action; released by RASO and CDHS.



NAVY










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Scale in Feet

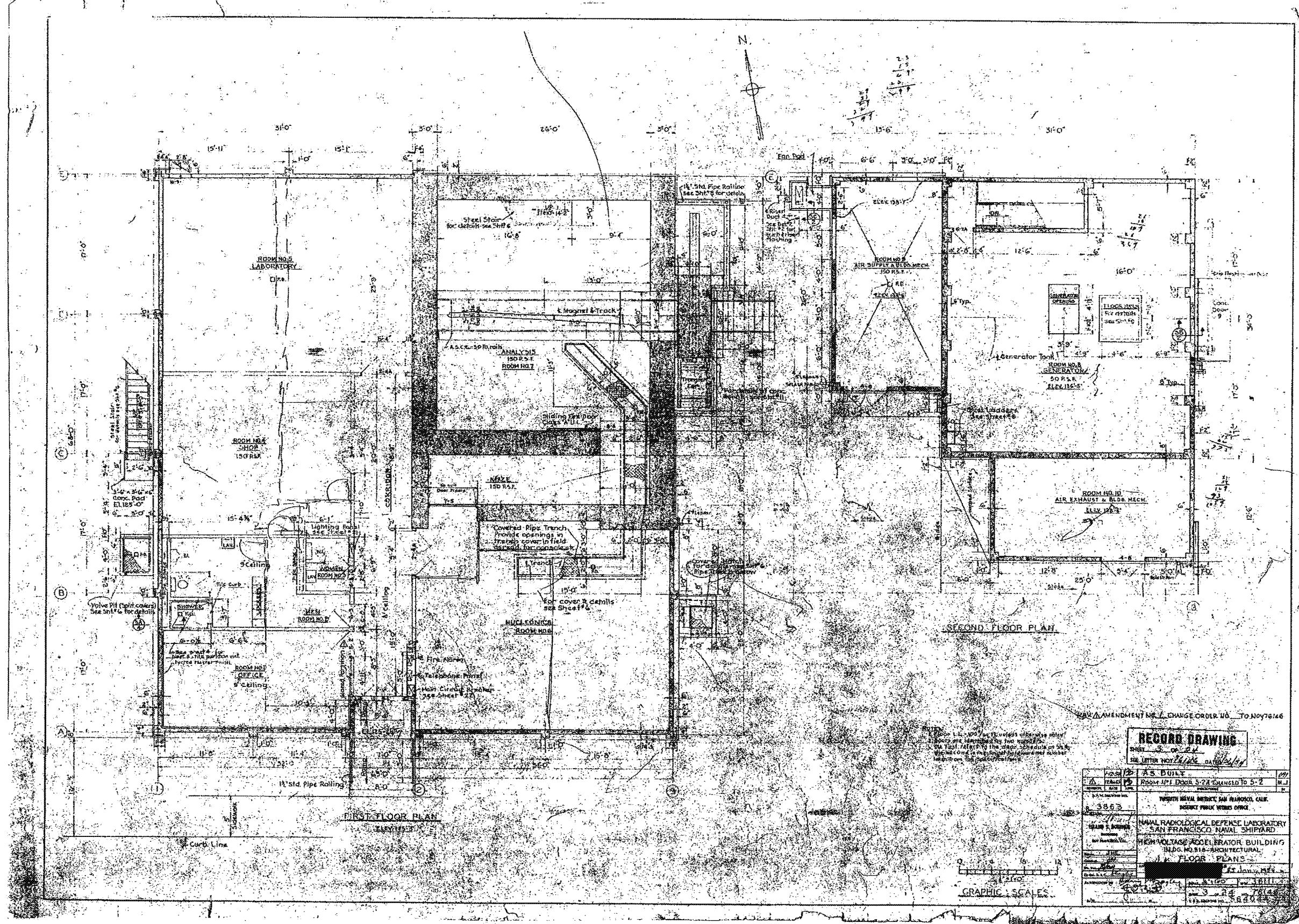
-  Impacted Site with Designation
-  Impacted Site with Designation (Demolished)
-  IR Site w/ Designation
-  Non - Impacted Building
-  Non-Impacted Building (Demolished)
-  Topographic Feature
-  Parcel Boundary

Hunters Point Naval Shipyard
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Assessment

Bldg. 816 Site Plan

August, 2004

Figure 8.3.1.1



Notes:

Not to Scale. Background image per Map ID 99.

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Historical Radiological
Assessment
August, 2004

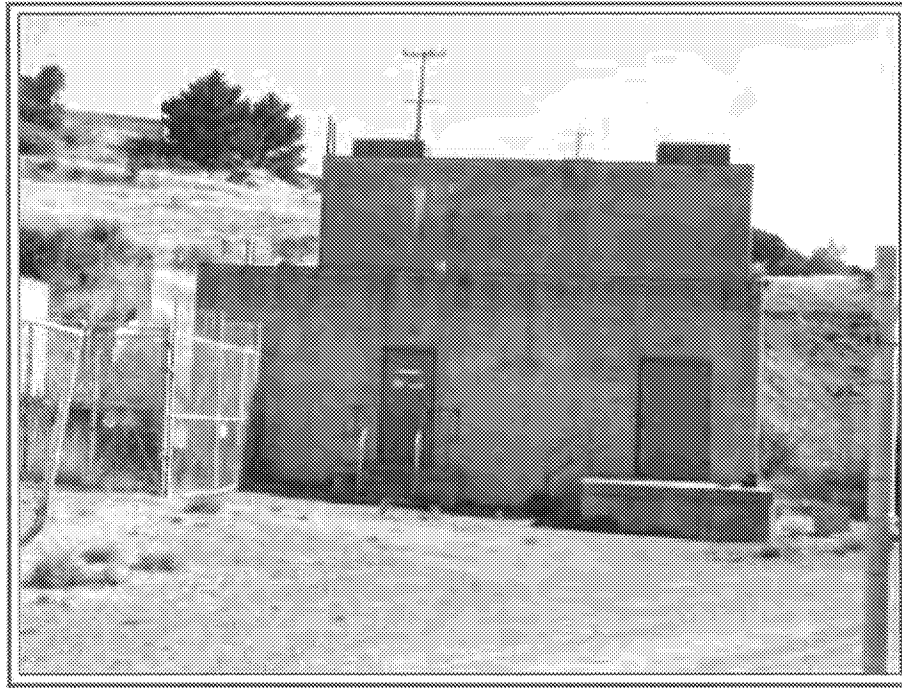


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Figure 8.3.1.1FP
Building 816 - Floor Plan

8.3.1.2 Building 821



Site Description: A two-story concrete laboratory building, used for the study of animal irradiation through electro-magnetic means (non-radionuclide generated). An electrical power substation is located outside of the western side of the building. Figure 8.3.1.2 provides a site plan.

Former Uses: One-MeV X-ray generator (HRA-2772, p 20) and X-ray laboratory.

Current Uses: Unoccupied.

Radionuclides of Concern: None.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey results met the release criteria.

1969 Final AEC clearance not needed (HRA-2772, p 20).

Contamination Potential: Unlikely.

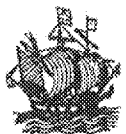
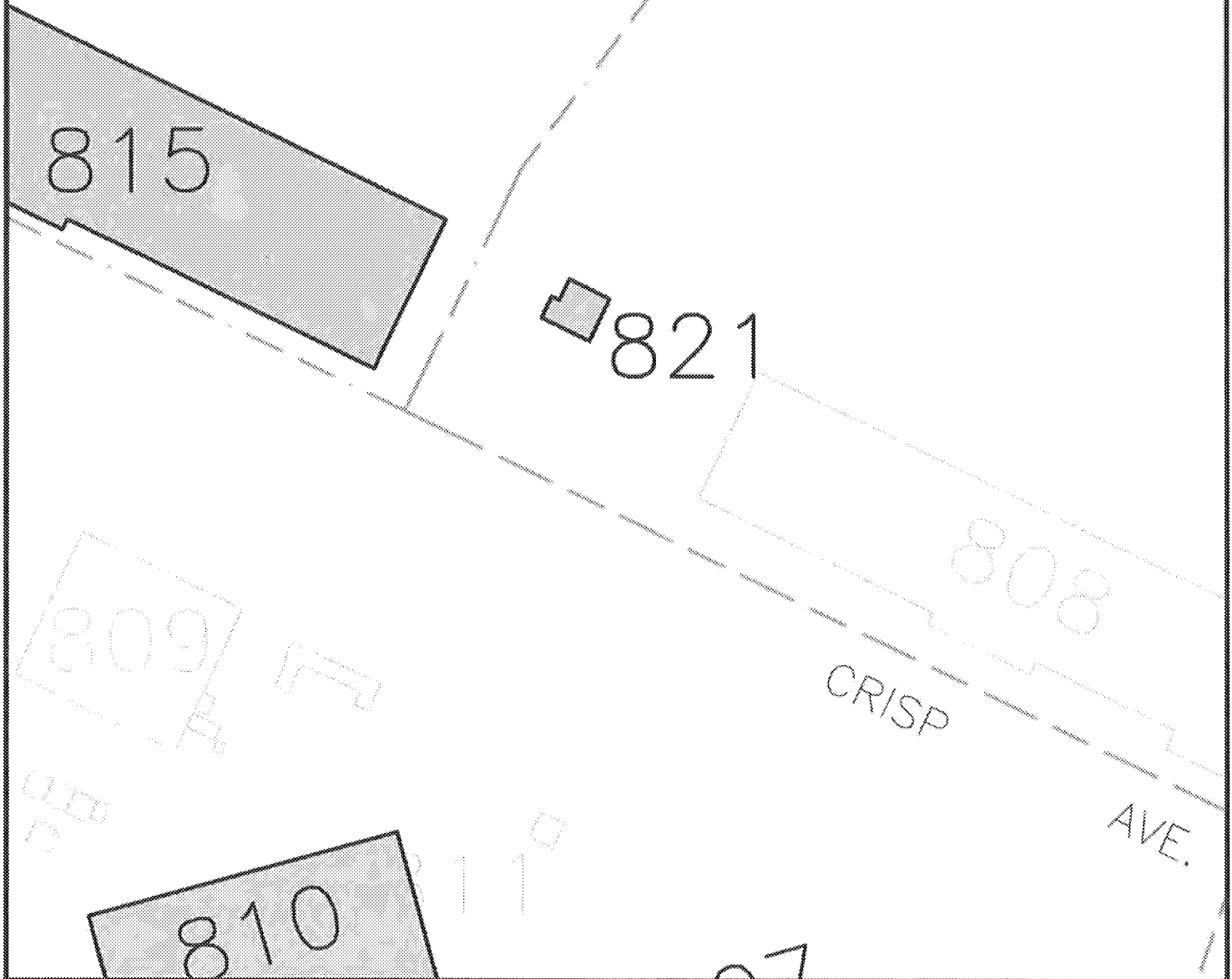
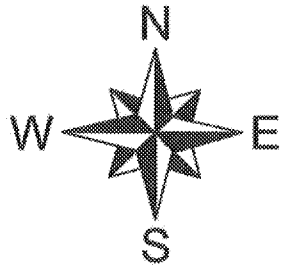
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures Site Description: None
Drainage Systems: None

Recommended Actions: No Further Action; released by RASO and CDHS.










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Scale in Feet

-  Impacted Site with Designation
-  Impacted Site with Designation (Demolished)
-  IR Site w/ Designation
-  Non - Impacted Building
-  Non-Impacted Building (Demolished)
-  Topographic Feature
-  Parcel Boundary

Hunters Point Naval Shipyard
 San Francisco CA
 Historical Radiological
 Assessment

Bldg. 821 Site Plan

August, 2004

Figure 8.3.1.2

8.3.1.3 Building 322 Site



Building Description: The former Building 322 was of WW II era administration building design, built from standardized Bureau of Yards and Docks plans (HRA-1118, p 22). A site plan is provided in Figure 8.3.1.2 above.

Former Uses: NRDL Office (HRA-1327 Encl 1, p 1), NRDL Instruments Branch offices prior to 1959 (HRA-2928, p 5), moved to Parcel A for use as the North Gate Pass Office in 1959 following clearance surveys by NRDL (HRA-333, p 16; HRA-4705). No further NRDL use while located in Parcel A. Information on the former site in Parcel D can be found in Section 8.3.4.5.

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

- 2004 Tetra Tech Foster Wheeler, Inc. demolition and survey for unrestricted release. Building surveyed for equipment and materials disposition prior to demolition activities. Equipment, materials, and building material released for commercial disposal. Site surveyed as Class 1 MARSSIM Final Status Survey for unrestricted release. Report submitted to regulators for review in July 2004.
- 1955 NRDL Survey. Cleared below release limits (HRA-224).

Contamination Potential: Unlikely, based on FSS preliminary results.

Contaminated Media: Indicated ratings reflect conditions anticipated prior to performance of FSS.

Surface Soil: Low
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways: Indicated ratings reflect conditions anticipated prior to performance of FSS.

Surface Soil: Low
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Free Release. Final Status Survey report under review by regulatory agencies.

8.3.2 Parcel B Impacted Sites

8.3.2.1 Building 103



Site Description: Built as a standard WW II wooden barracks, Building 103 is a long, narrow rectangular building topped by a shallow gabled roof with narrow eaves. It sits alongside a pair of similar buildings at the base of the hill (HRA-1118, p 58). A site plan is provided in Figure 8.3.2.1.

Former Uses: Submarine barracks, 1951 (HRA-2963); decontamination center for OPERATION CROSSROADS personnel (HRA-1483).

Current Uses: Navy lease to San Francisco Redevelopment Agency, The Point (Artists).

Radionuclides of Concern: Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey completed.

Contamination Potential: Unlikely.

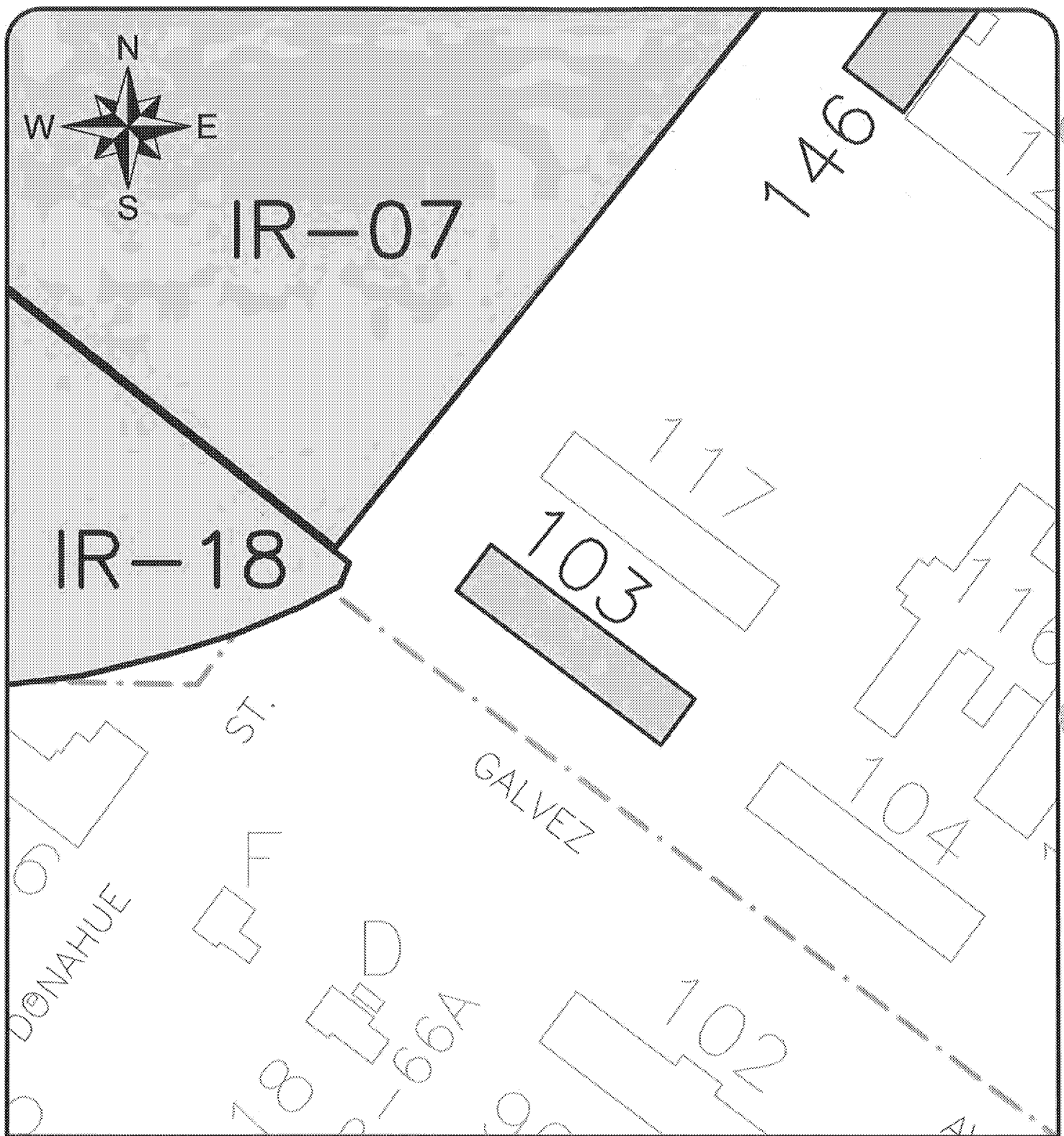
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary

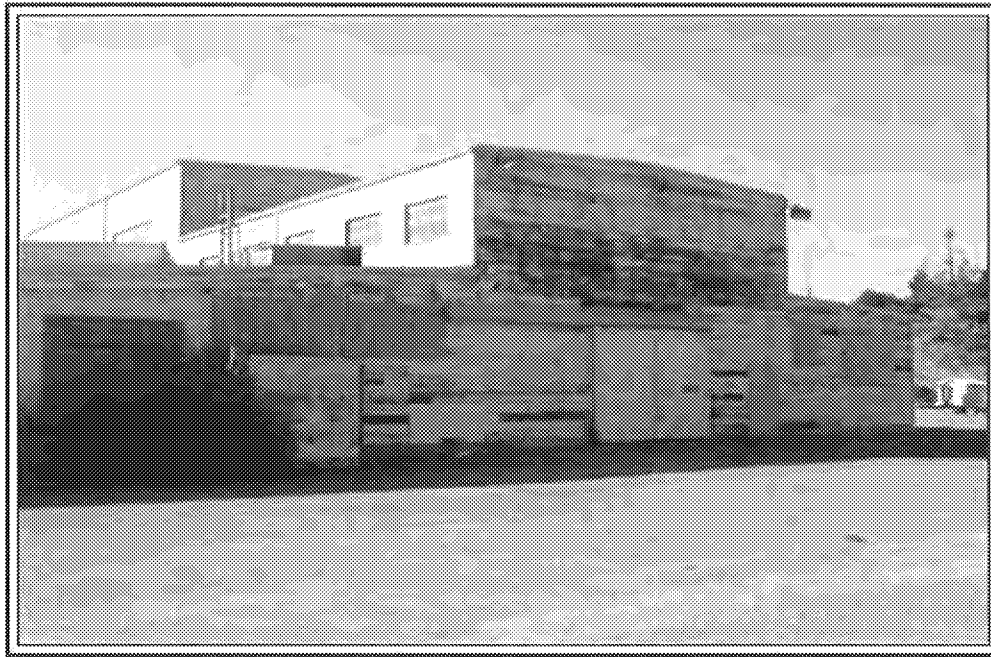
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Assessment

Bldg. 103 Site Plan

January, 2004

Figure 8.3.2.1

8.3.2.2 Building 113



Site Description: Building 113 is a rambling three-story wood-framed shop located in the ex-submarine repair area. It is sided in horizontal boards and has a shallow gabled roof. The building has a central three-story element, a T-shaped two-story element, and a rectangular first story. A site plan is provided in Figure 8.3.2.2, and a floor plan is provided in Figure 8.3.2.2FP.

Former Uses: Tug maintenance, salvage diver facility, torpedo storage and overhaul (1951-1964), and sample storage from atomic weapons tests (HRA-2705 Encl A).

Current Uses: San Francisco Police Department storage building.

Radionuclides of Concern: Sr-90, Pu-239, and Cs-137.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey completed.

1996 PRC - No survey required. Determined that only sealed check sources were used.

Contamination Potential: Unlikely.

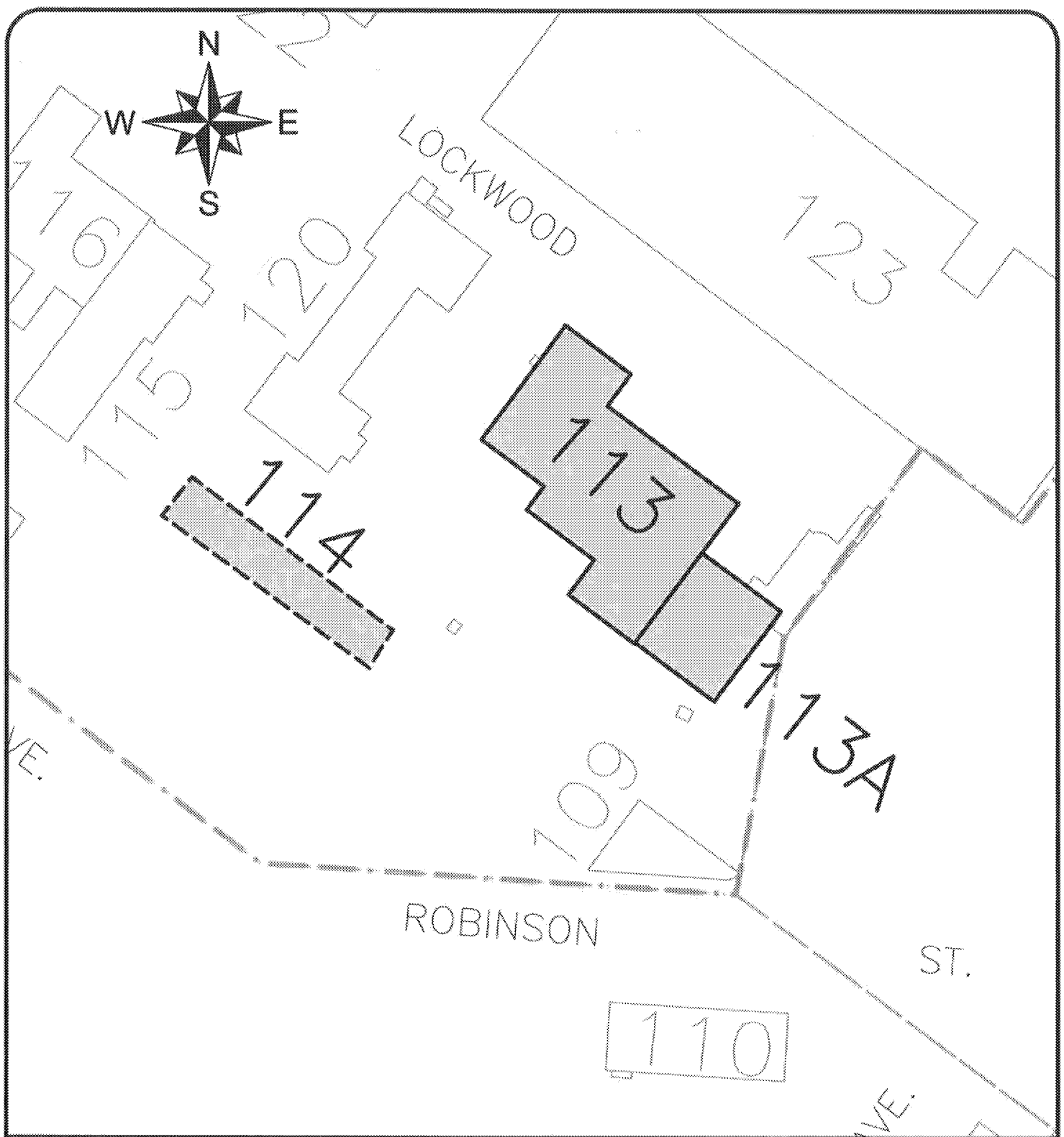
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Action: Review Final Status Survey Report.



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


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100 0 100



Scale in Feet

-  Impacted Site with Designation
-  Impacted Site with Designation (Demolished)
-  Impacted IR Site w/ Designation
-  Non - Impacted Building
-  Non-Impacted Building (Demolished)
-  Topographic Feature
-  Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 113, 113A & 114 Site Plan

January, 2004

Figure 8.3.2.2

8.3.2.3 Building 113A



Site Description: Building 113A is a 25-by-25-foot concrete storage vault enclosed by a corrugated, metal-sided, shallow gabled roofed structure that is immediately adjacent to Building 113 (HRA-2798). The building is currently labeled as Building 114, although this is historically incorrect. Figure 8.3.2.2 above provides a site plan of Building 113A, and a floor plan is provided in Figure 8.3.2.3FP.

Former Uses: Torpedo storage building, Non-Destructive Test Facility (Radiography) (HRA-1472 Supplement 1), Machine and Maintenance Shop, Shipyard Analytical Laboratory, Radioactive Material Storage Building, Radiographer's Vault, and radioactive waste storage facility. The building was also used to store sheet lead removed from Building 364 (HRA-600, p 2).

Current Uses: Occupied by Smith-Emery.

Radionuclides of Concern: Cs-137 and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigations. Survey completed.

1978 Scoping surveys by RASO.

1974 Shipyard closure survey. No detectable activity.

Contamination Potential: Unlikely.

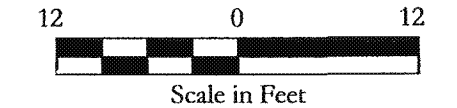
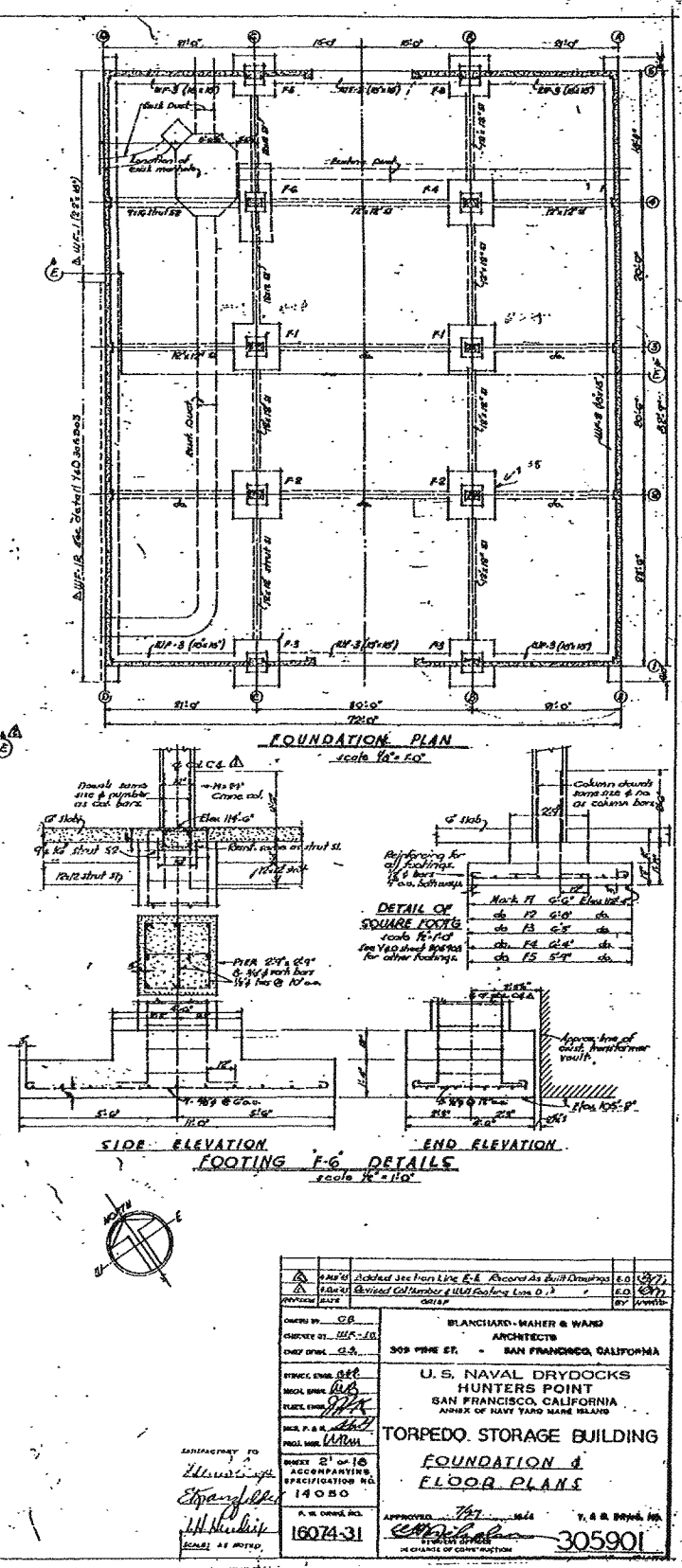
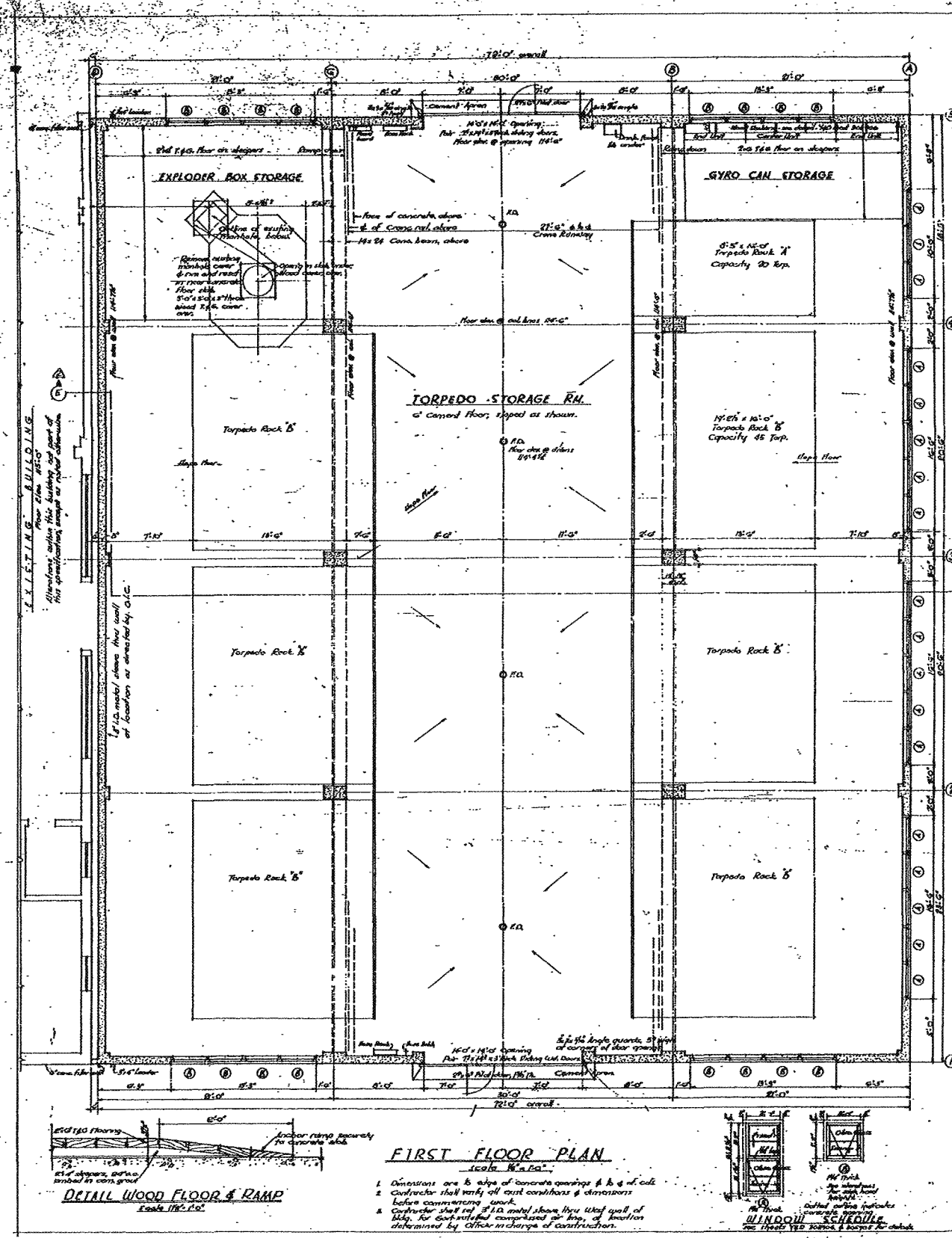
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Action: Review Final Status Survey Report.



Notes:
Background image per Map ID 46.

Hunters Point Naval Shipyard San Francisco CA Historical Radiological Assessment

May, 2003

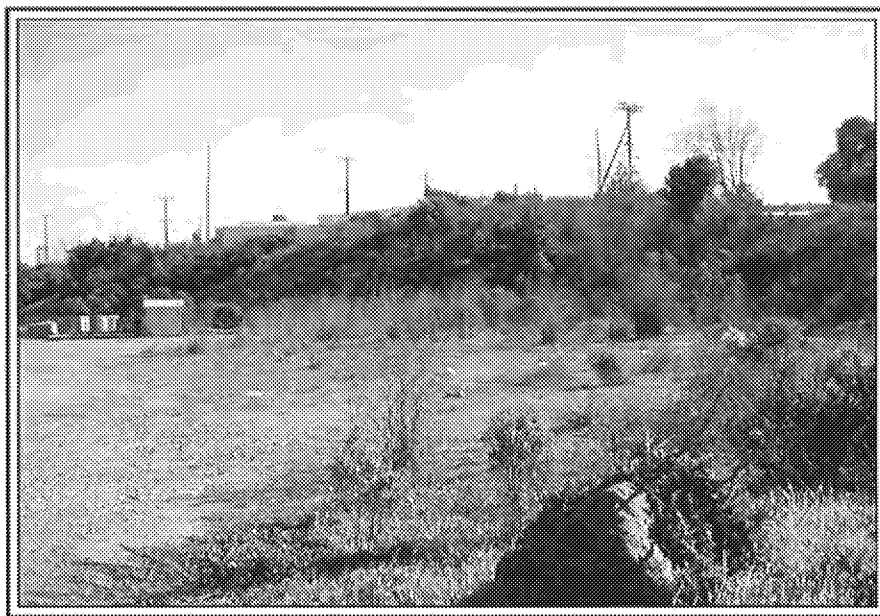


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Figure 8.3.2.2 FP
Building 113 - Floor Plan

8.3.2.4 *Building 114 Site*



Site Description: Building has been demolished, and actual building descriptions are not available. It has been incorrectly identified as Building 113A in other documents. A site plan is provided in Figure 8.3.2.2 above.

Former Uses: NRDL Design Branch and Technical Library – 1951 (HRA-2963).

Current Uses: Demolished.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

1996 PRC - no survey required, no radioactive material stored or used in building.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey.

8.3.2.5 *Building 130*



Site Description: Building 130 is a wood-framed shop building located in the former submarine repair area. Built in 1944, the building differs from other shops in that it includes open sheds on both sides and an almost flat, shallow gabled roof. The building also includes wooden sliding industrial doors at either end. A site plan of Building 130 is provided in Figure 8.3.2.5.

Former Uses: Occupied by Protective Finishes Company (1994), PRC used the building as a LLRW storage area (Ra-226 and IDW in 1994) (HRA-1118, p 58), Shop Service (1968 to 1973), pipe fitter shop, general shops, ship repair shop, machine shop, and metal working shop.

Current Uses: Environmental HAZMAT storage.

Radionuclides of Concern: Ra-226 and Cs-137.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Elevated readings noted and attributed to naturally occurring radionuclides. Survey complete.

Contamination Potential: Unlikely.

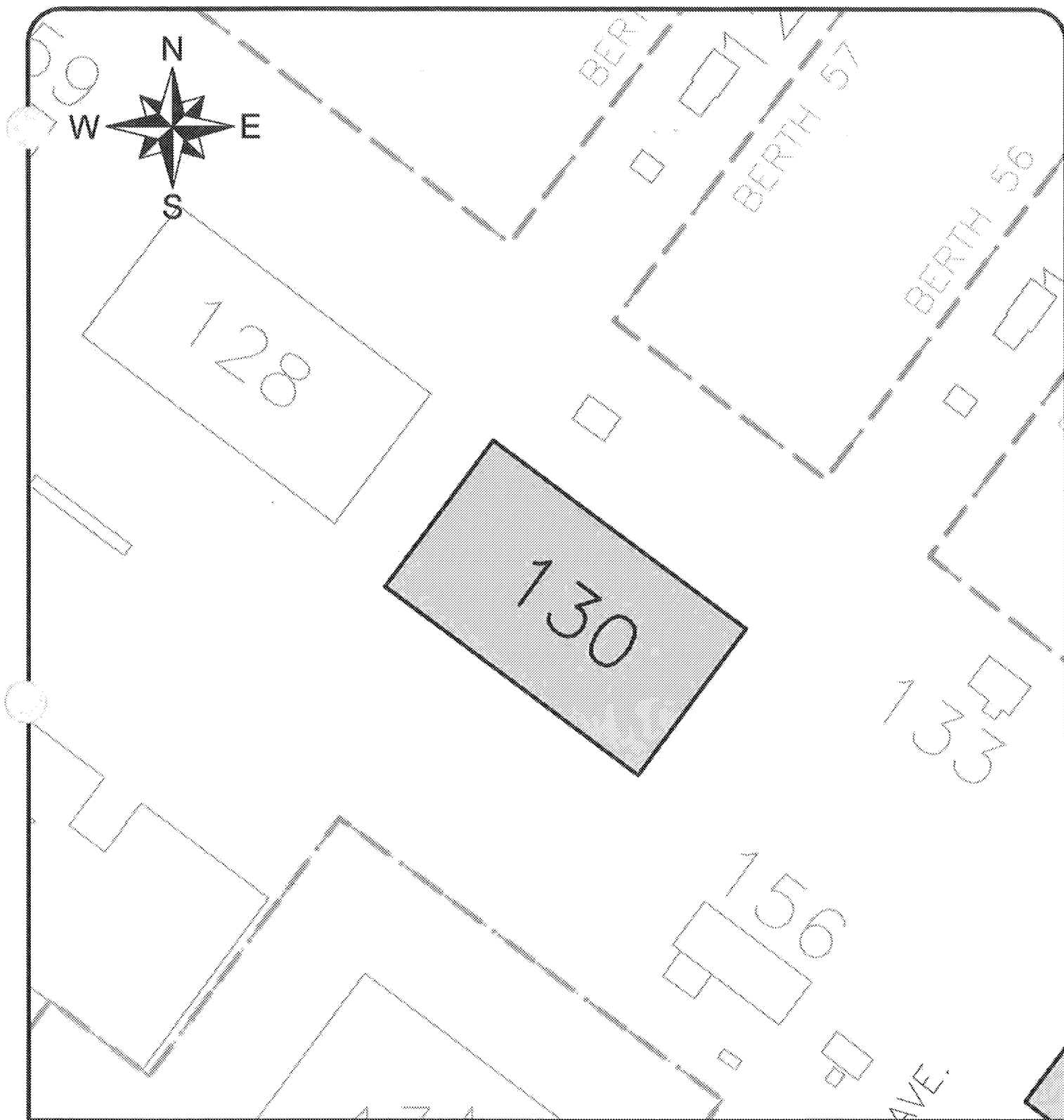
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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100 0 100



Scale in Feet



Impacted Site with Designation



Impacted Site with Designation (Demolished)



Impacted IR Site w/ Designation



Non - Impacted Building



Non-Impacted Building (Demolished)



Topographic Feature

Parcel Boundary

All Berths shown are Impacted

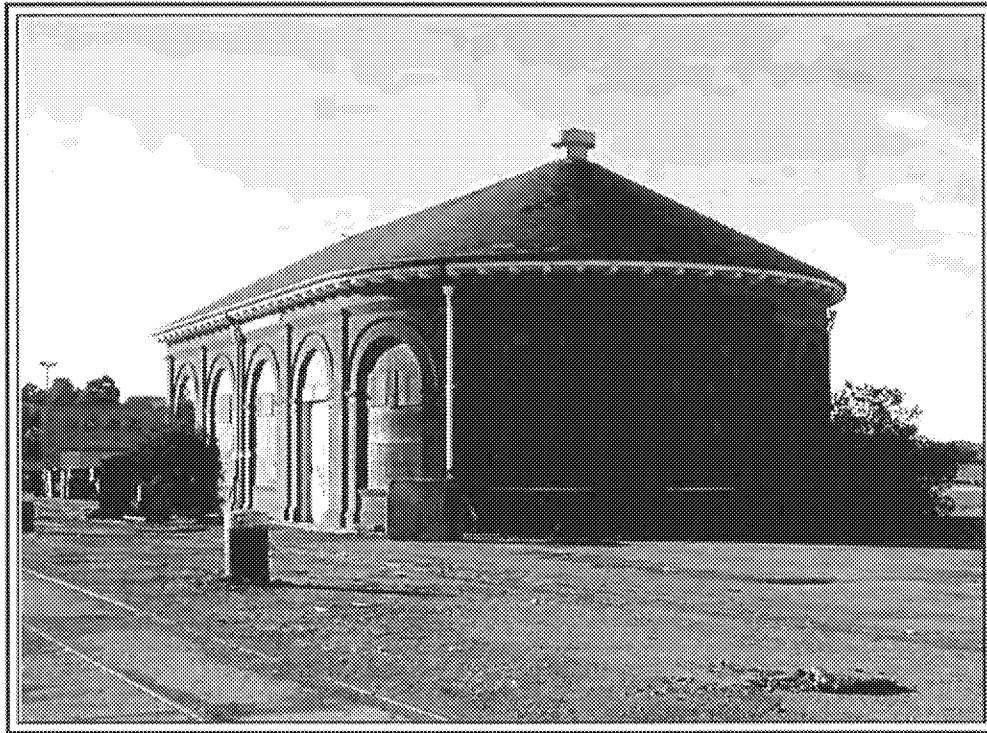
Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 130 Site Plan

January, 2004

Figure 8.3.2.5

8.3.2.6 *Building 140 and Discharge Channel*



Site Description: Building A is a one-story brick building shaped as a rectangle with a rounded eastern end resembling an apse. The building measures about 96 by 56 feet and is located north of Drydock 3, about midway along the drydock (HRA-1117, p 133). A channel for water from Drydock 3 passes in a straight line north from the drydock through the pumphouse to the Bay (HRA-4689). A site plan of Building 140 is provided in Figure 8.3.2.6.

Former Uses: Drydock Pumphouse No. 3 and discharge channel (HRA-1117, p 133).

Current Uses: Unoccupied.

Radionuclides of Concern: Ra-226, Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

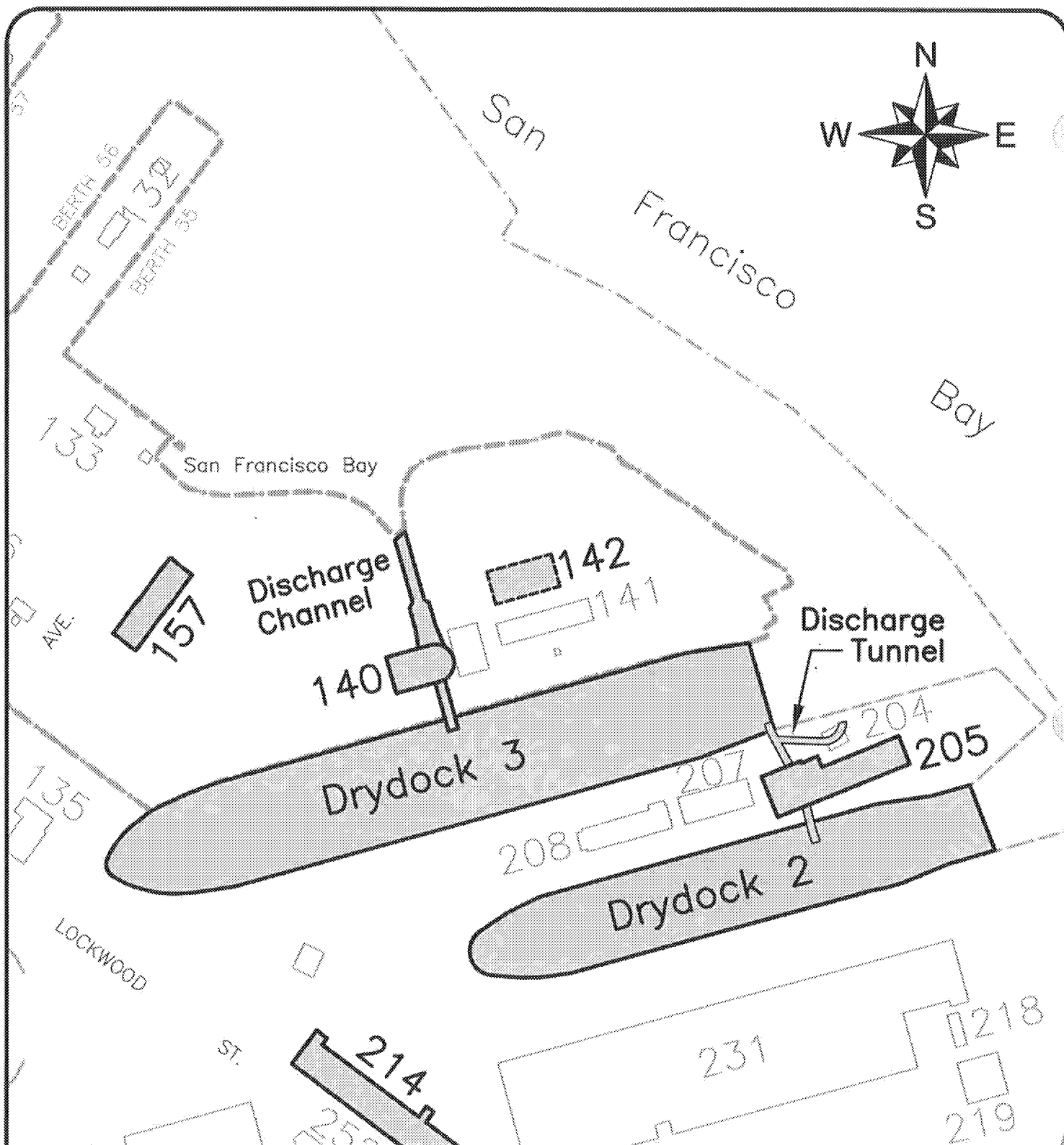
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey of structure, equipment, and discharge channel. Characterization and remediation if contamination is found. Final Status Survey.



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200 0 200



Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 140, 142 & Discharge Channel
Site Plan
January, 2004

Figure 8.3.2.6

8.3.2.7 *Building 142*



Site Description: Building 142 is a partially demolished concrete air raid shelter thought to be similar to Building 224. It is unclear from historical references whether this structure was above or below ground (HRA-2963). A site plan is provided in Figure 8.3.2.6 above.

Former Uses: Air Raid Shelter A (HRA-2963), weapons test high-level sample storage, and low background sample counting room (HRA-405).

Current Uses: Unoccupied; partially demolished.

Radionuclides of Concern: Ra-226, Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey. Characterization Survey and remediation if contamination is found. Final Status Survey.

8.3.2.8 *Building 146*



Site Description: Building 146 is a wood-framed, shallow gabled roofed shop with windows throughout that was built in 1945. The building is two storied, sided in stucco on the first story and asbestos shingles on the second. Large sliding wooden doors provide access to the building. A site plan is provided in Figure 8.3.2.8, and a floor plan is provided in Figure 8.3.2.8FP.

Former Uses: Industrial and Photo Laboratory (1951-1964), General Shops, Radioactive Waste Storage Area, and Radioluminescent Device Turn-In Building (HRA-2811, p 2; HRA-2829).

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Class 3 survey complete.

1974 Shipyard closure survey. No activity detected.

Contamination Potential: Likely; reclassified from Phase V Class 3 survey based on new information that the building was radioluminescent device turn-in location.

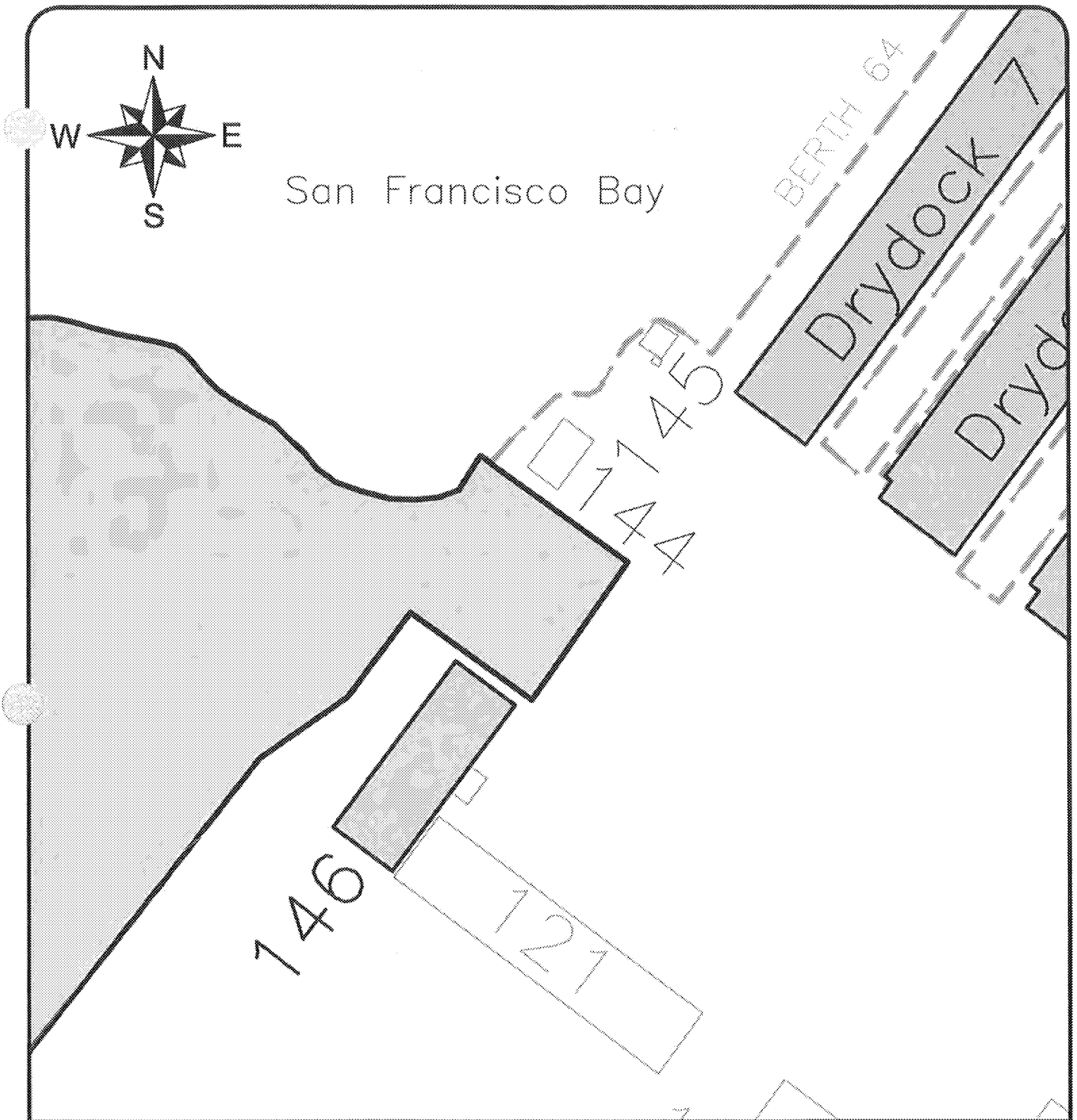
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Characterization Survey. Remediation if contamination is found. Final Status Survey.



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Phone (925) 443-7967 Fax (925) 443-0119

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Scale in Feet

- Impacted Site with Designation
 - Impacted Site with Designation (Demolished)
 - Impacted IR Site w/ Designation
 - Non - Impacted Building
 - Non-Impacted Building (Demolished)
 - Topographic Feature
 - Parcel Boundary
- All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 146 Site Plan

January, 2004

Figure 8.3.2.8

8.3.2.9 *Building 157*



Site Description: Building 157 is a corrugated metal, wood-framed structure approximately 40 feet by 140 feet in size. Specific historical descriptions of the building were not found. A site plan is provided in Figure 8.3.2.9.

Former Uses: Shipyard Industrial Laboratory, non-destructive testing, Sound Laboratory, Metals Testing Center (Radiography), and Metal Shop (HRA-547).

Current Uses: Unoccupied.

Radionuclides of Concern: Co-60, Cs-137, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

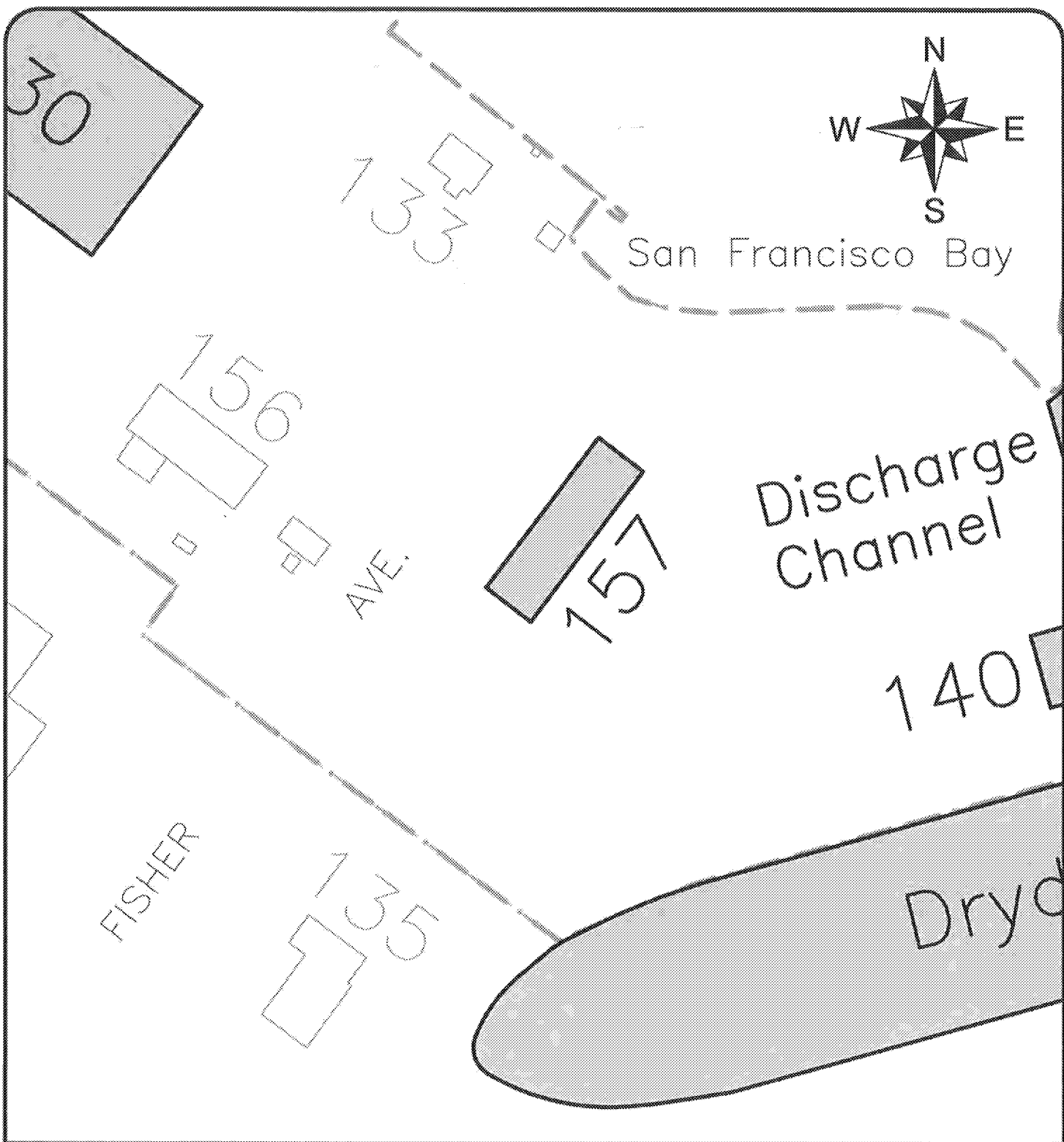
Contaminated Media:

- Surface Soil: None
- Subsurface Soil: None
- Sediment: None
- Surface Water: None
- Groundwater: None
- Air: Low: None
- Structures: Low
- Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey. Characterization and remediation if contamination is found. Final Status Survey.



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100

0

100



Scale in Feet



Impacted Site with Designation



Impacted Site with Designation (Demolished)



IR Site w/ Designation



Non - Impacted Building



Non-Impacted Building (Demolished)



Topographic Feature



Parcel Boundary

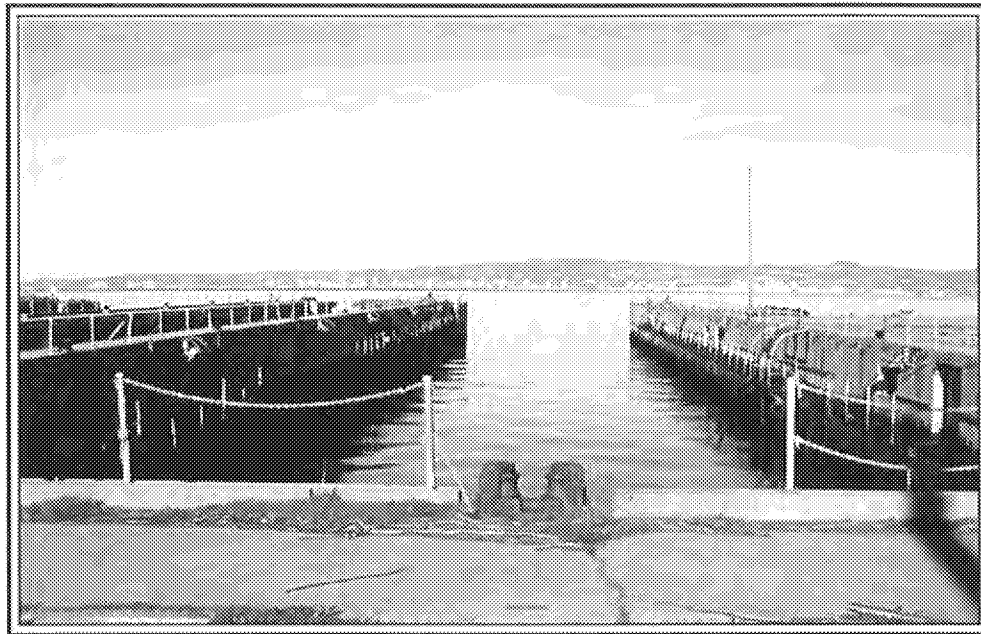
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Historical Radiological
Assessment

Bldg. 157 Site Plan

January, 2004

Figure 8.3.2.9

8.3.2.10 Drydock 5



Site Description: Built in 1944, the chief function of Drydock 5 was submarine repair, but it was also capable of housing destroyers and other relatively small vessels. The drydock is 420 feet by 60 feet, with a gate that is hinged at the bottom that flaps down to allow the vessel to enter. The drydock was dewatered by four 20,000-gallons per minute (gpm) pumps. Two pumps were located at each side of the Bay end of the dock (HRA-4683). A drydock site plan is provided in Figure 8.3.2.10.

Former Uses: Decontamination of ships from OPERATION CROSSROADS and Ship Repair (Submarines).

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Sr-90, Pu-239, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

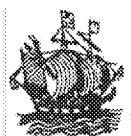
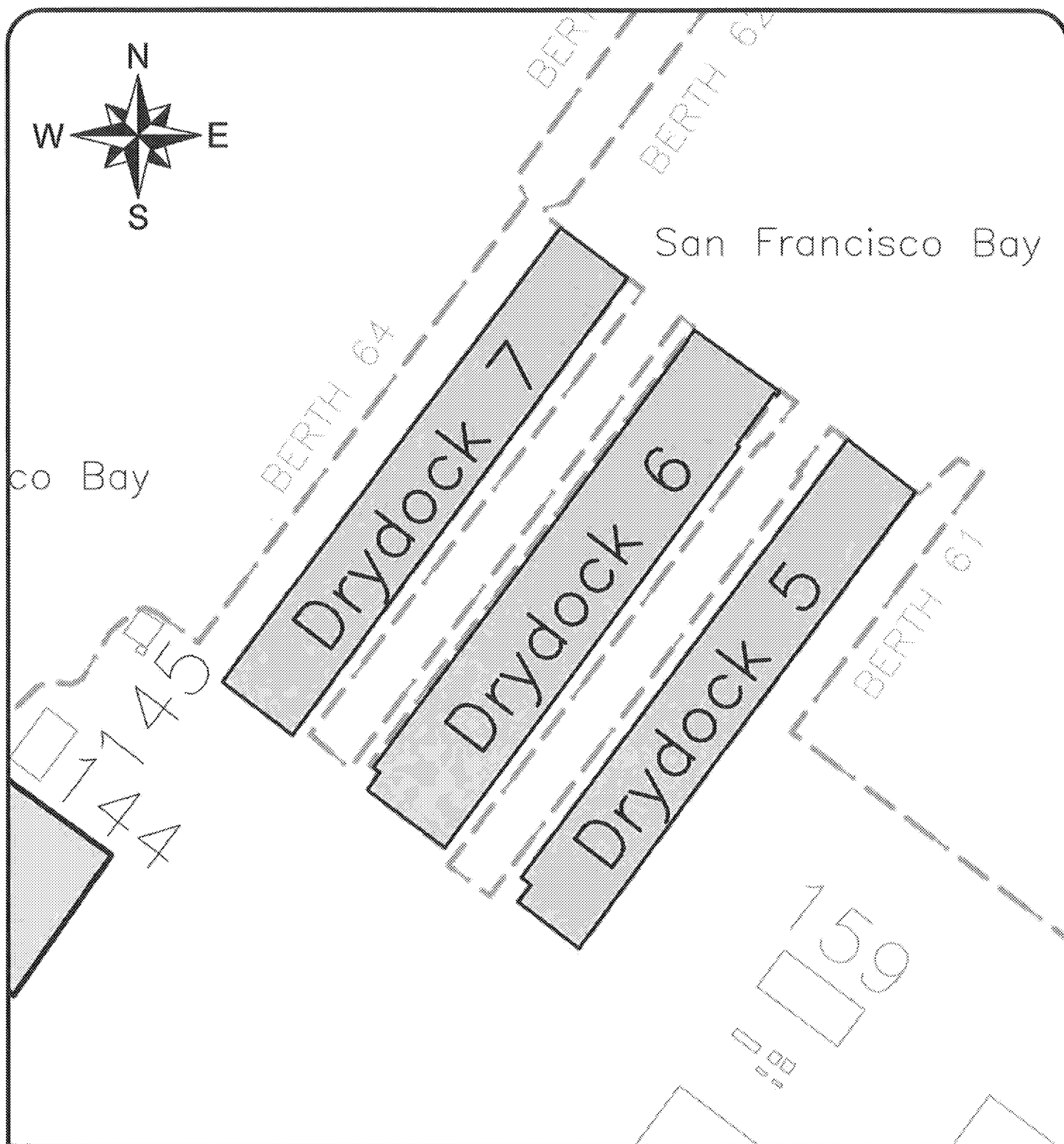
Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey of structure and pumping equipment.
Characterization and remediation if contamination is found. Final Status Survey.



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








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100 0 100



Scale in Feet

-  Impacted Site with Designation
 -  Impacted Site with Designation (Demolished)
 -  Impacted IR Site w/ Designation
 -  Non - Impacted Building
 -  Non-Impacted Building (Demolished)
 -  Topographic Feature
 -  Parcel Boundary
- All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Drydock 5, 6 & 7 Site Plan

January, 2004

Figure 8.3.2.10

8.3.2.11 Drydock 6



Site Description: Drydock 6 was built in 1944 for submarine repair, but was also capable of housing destroyers and other relatively small vessels. The drydock is 420 feet by 75 feet, with a gate that is hinged at the bottom that flaps down to allow the vessel to enter. The drydock was dewatered by four 20,000-gpm pumps. Two pumps were located at each side of the Bay end of the dock (HRA-4683). A drydock site plan of is provided in Figure 8.3.2.10 above.

Former Uses: Decontamination Drydock for OPERATION CROSSROADS and Ship Repair (Submarines).

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Sr-90, Pu-239, and Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Class 3 survey completed.

1947 HPS - Drydock 6; slight contamination on cap blocks, ships brow, securing lines, fire hose, and two electric cables.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Review Final Status Survey Report.

8.3.2.12 Drydock 7



Site Description: Drydock 7 was built in 1944 for submarine repair, but was also capable of housing destroyers and other relatively small vessels. The drydock is 420 feet by 60 feet, with a gate that is hinged at the bottom that flaps down to allow the vessel to enter. The drydock was dewatered by four 20,000-gpm pumps. Two pumps were located at each side of the Bay end of the dock (HRA-4683). A drydock site plan is provided in Figure 8.3.2.10 above.

Former Uses: Possible Decontamination Drydock for OPERATION CROSSROADS and Ship Repair (Submarines).

Current Uses: Unused.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey of structure and pumping equipment.
Characterization and remediation if contamination is found. Final Status Survey.

8.3.2.13 IR-07



Site Description: IR-07 is a former disposal area located northeast of Building 916 and on a line 25 feet below Donahue Street. IR-07 is approximately 700 feet by 700 feet in size. A site plan is provided in Figure 8.3.2.13.

Former Uses: Flat land area built by the Navy used to support conventional (non-nuclear) submarine maintenance. Potential disposal of waste from decontamination of ships from OPERATION CROSSROADS.

Current Uses: Undeveloped open land.

Radionuclides of Concern: Ra-226, Cs-137, Sr-90, and Pu-239.

Previous Radiological Investigations:

- 1999 IT Corporation sandblast media samples. No activity exceeding background levels.
- 1994 EPA soil samples. No detectable activity above background
- 1993 PRC, Phase II Radiological Investigation. No readings exceeding background.
- 1992 Phase I SCRS. General area gamma anomalies were noted in sandy soils, soil samples indicated Ra-226 and daughters and other naturally occurring radionuclides.
- 1988 HLA - conducted survey; results indicated background levels.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey. Characterization and remediation if contamination is found. Final Status Survey.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: Low
Subsurface Soil: Low
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: Low
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: None
Drainage Systems: None

Recommended Actions: Scoping Survey. Characterization and remediation if contamination is found. Final Status Survey.

8.3.3 Parcel C Impacted Sites

8.3.3.1 Building 203



Site Description: Building 203 is a large reinforced concrete building housing a power plant (HRA-2963). Constructed in 1943 and extended in 1945, the building measures 152 feet by 137 feet (HRA-1118, p 58). The building is also referred to as Substation H (HRA-4667). It has a flat reinforced concrete roof with a slight overhang. The building includes a major addition that is sided in corrugated metal, likely the 1945 extension. A building site plan is provided in Figure 8.3.3.1, and a floor plan is provided in Figure 8.3.3.1FP.

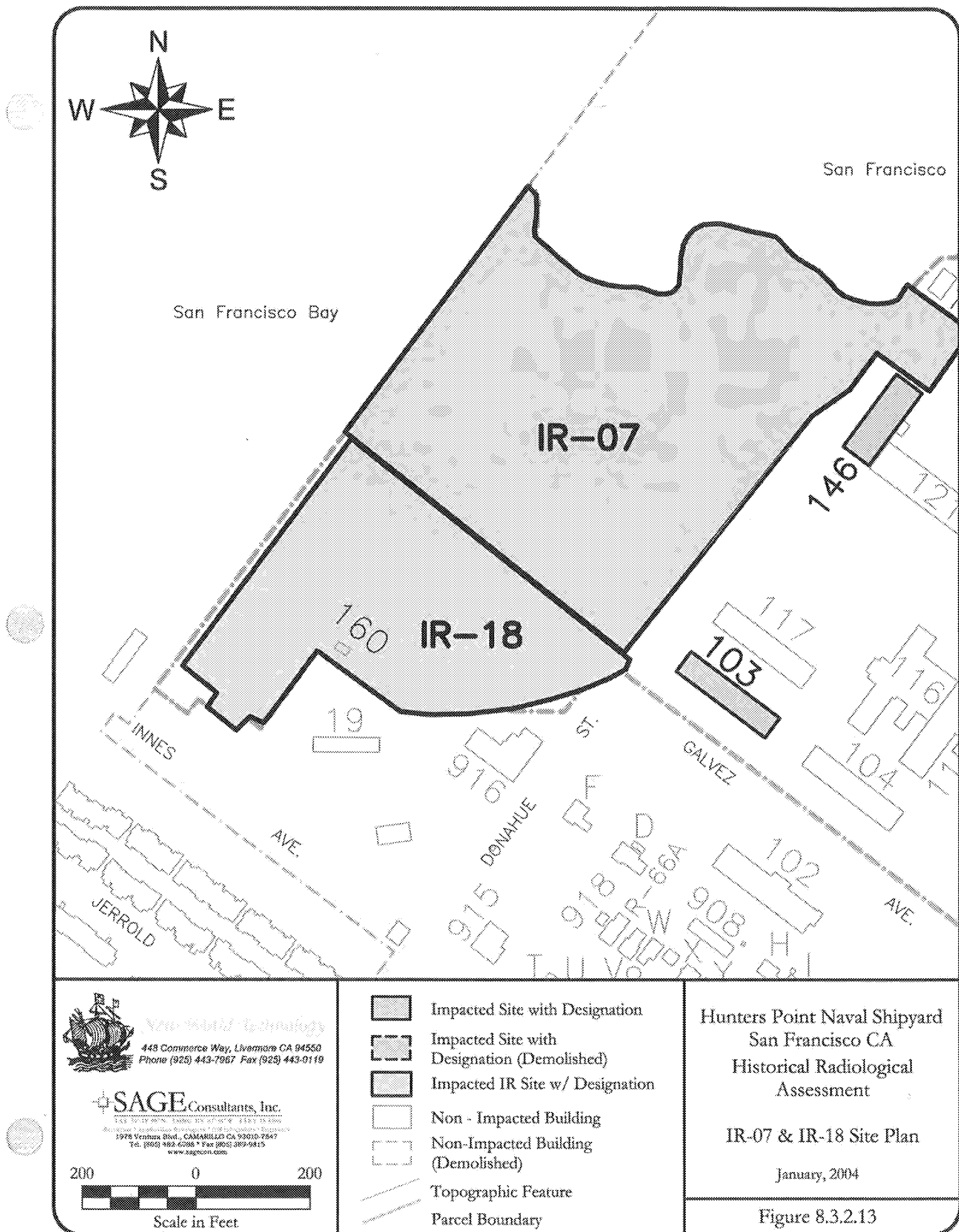
Former Uses: Power Plant (HRA-1118, p 58; HRA-2963; HRA-4667). This is one of two sites suspected of burning of fuel oil from three OPERATION CROSSROADS target ships.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Sr-90, Pu-239, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.



8.3.2.14 IR-18



Site Description: IR-18 is a former fill area approximately one-third of which is located northeast of Building 916 and on a line 25 feet below Donahue Street. IR-18 is approximately 500 feet by 500 feet in size. A site plan is provided in Figure 8.3.2.13 above.

Former Uses: Flat land area built by the Navy. Waste oil disposal area (HRA-2991), potentially used for disposal of OPERATION CROSSROADS decontamination materials, and recreational vehicle camping/parking.

Current Uses: Undeveloped open land.

Radionuclides of Concern: Ra-226, Cs-137, Sr-90, Pu-239 (OPERATION CROSSROADS sandblast spoils).

Previous Radiological Investigations:

- 1994 EPA soil samples. No detectable activity above background. EPA attributed activity to naturally occurring granitic materials.
- 1992 Phase I SCRS. General area gamma anomalies were noted in sandy soils; soil samples indicated Ra-226 and daughters and other naturally occurring radionuclides.
- 1992 PRC radon flux testing – No levels exceeding background levels.

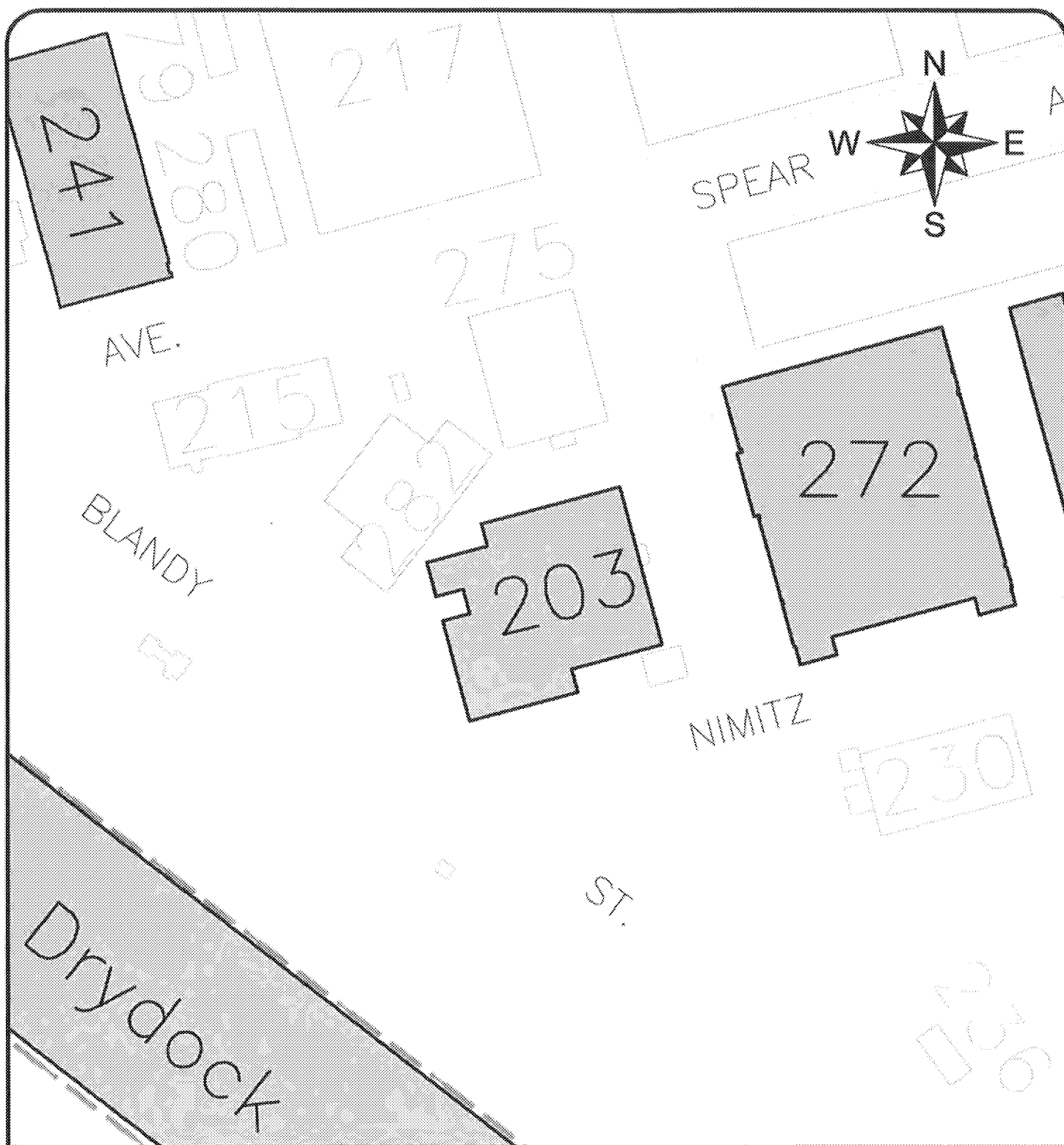
Contaminated Media:

Surface Soil: Low
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: Low
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Scoping Survey. Characterization and remediation if contamination is found. Final Status Survey.



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448 Commerce Way, Livermore CA 94550
Phone (925) 443-7967 Fax (925) 443-0119



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100 0 100



Scale in Feet



Impacted Site with Designation



Impacted Site with Designation (Demolished)



IR Site w/ Designation



Non - Impacted Building



Non-Impacted Building (Demolished)



Topographic Feature



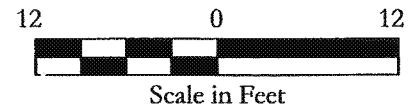
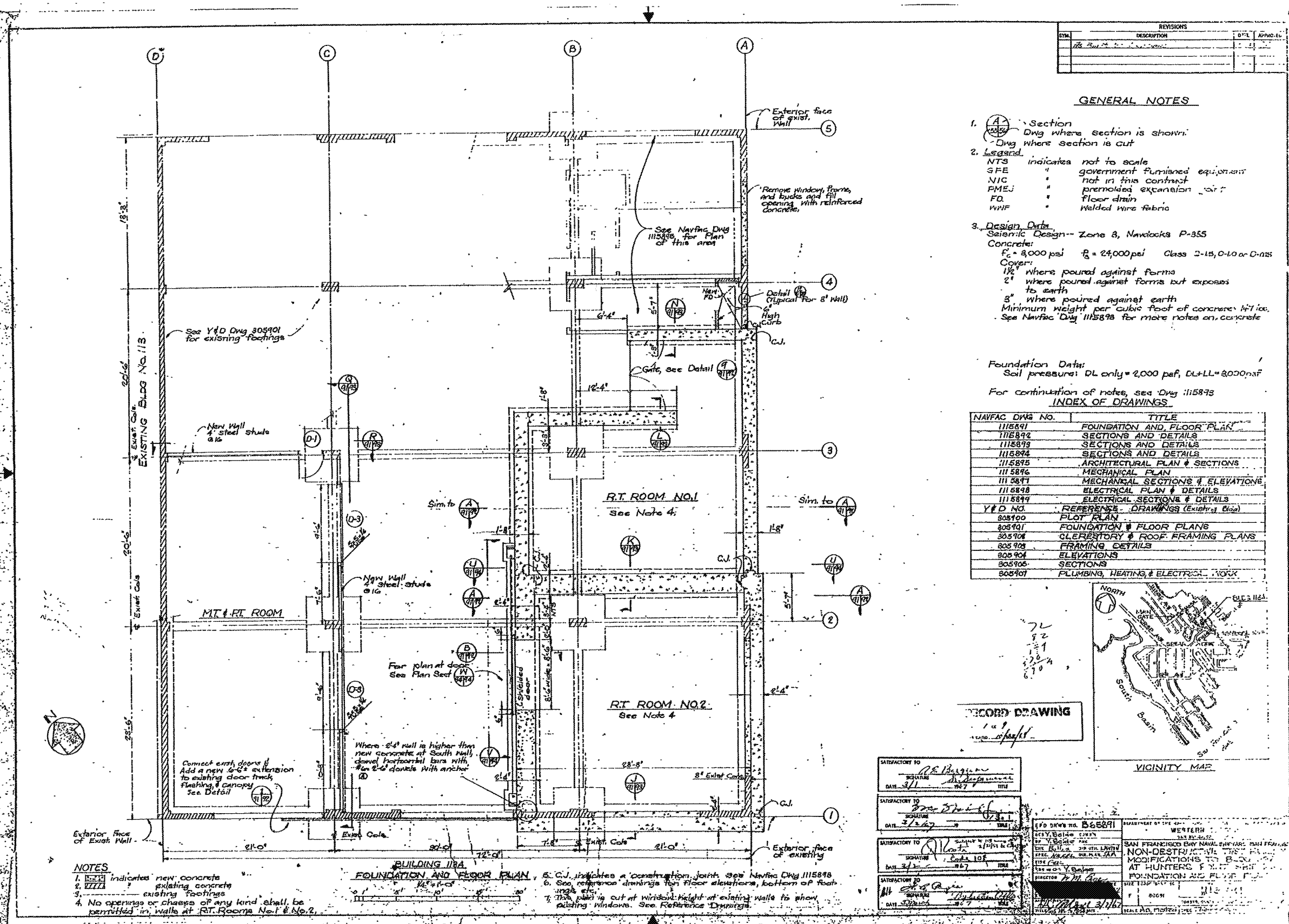
Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 203 Site Plan

January, 2004

Figure 8.3.3.1



Notes:

Background image per Map ID 42.

Hunters Point Naval Shipyard
San Francisco CA
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May, 2003

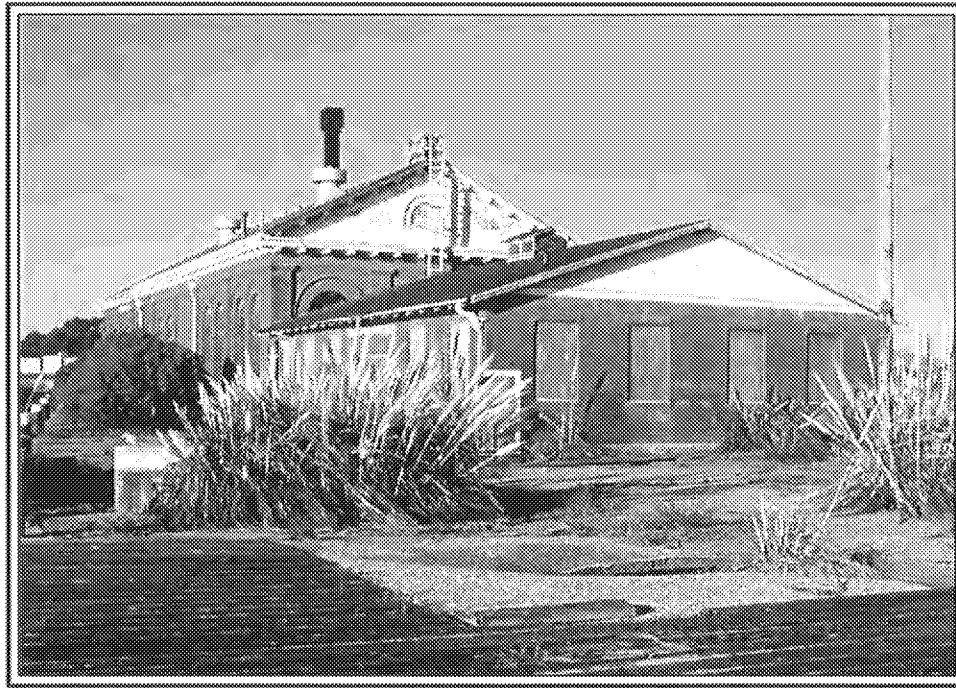


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448 Commerce Way, Livermore CA 94550
Phone (925) 443-7967 Fax (925) 443-0119

SAGE Consultants, Inc.
13734 VIA VENTURA, LONG BEACH, CA 90801
1978 Ventura Blvd., CAMARILLO CA 93010-7847
Tel. (805) 482-6088 • Fax (805) 389-9815
www.sagecon.com

Figure 8.3.2.3 FP
Building 113A - Floor Plan

8.3.3.2 *Building 205 and Discharge Channel*



Site Description: Building 205 is a single-story L-shaped brick building, measuring 211 by 61 feet. Two WW II era additions were made to the rear of the original building. The building houses the pumping machinery for Drydock 2 (HRA-1119, p 54; HRA-4667). A discharge tunnel connects the building to the drydock. There is also a channel connecting the building to Drydock 3 (HRA-4686). A site plan is provided in Figure 8.3.3.2.

Former Uses: Pumphouse for Drydock 2.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Sr-90, and Ra-226.

Previous Radiological Investigations: None.

Contamination Potential: Unlikely.

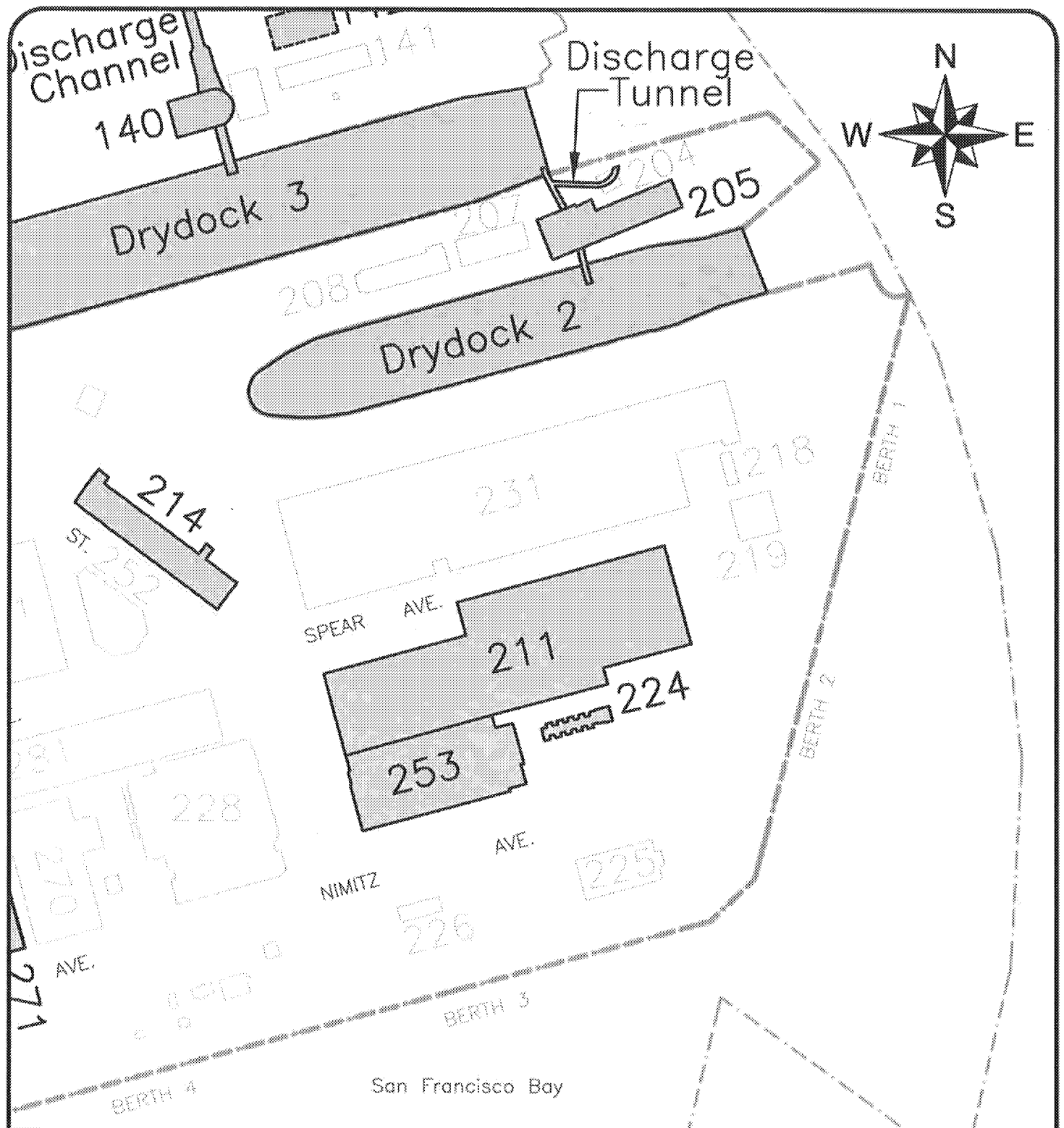
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low

Recommended Actions: Scoping Survey. Characterization and remediation if contamination is found. Final Status Survey.



448 Commerce Way, Livermore CA 94550
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SAGE Consultants, Inc.

1979 Ventura Blvd., CAMARILLO CA 93010-7947
Tel. (805) 482-6088 • Fax (805) 399-9512
www.sagecon.com

200 0 200



Scale in Feet

- Impacted Site with Designation
- Impacted Site with Designation (Demolished)
- Impacted IR Site w/ Designation
- Non - Impacted Building
- Non-Impacted Building (Demolished)
- Topographic Feature
- Parcel Boundary
- All Berths shown are Impacted

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 205, 211, 214, 224, 253
Site Plan

January, 2004

Figure 8.3.3.2

8.3.3.3 *Building 211*



Site Description: Building 211 is a three-story concrete-framed, curtain-walled building that was built in 1942 (HRA-1118, p 92). It is a large warehouse-type building, with a large gantry for craning materials to the upper stories. Building 211 is attached to Building 253 (HRA-1118, p 94). A building site plan is provided in Figure 8.3.3.2 above.

Former Uses: Machinery and electrical test/repair shop (HRA-2963; HRA-4667) and contractor LLRW storage site.

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Ra-226, and Th-232.

Previous Radiological Investigations: NWT Phase V investigation. There is a small area of Th-232 contamination on the concrete floor.

Contamination Potential: Known-Continued Access: Th-232 from refractory compound and welding electrodes.

Contaminated Media:

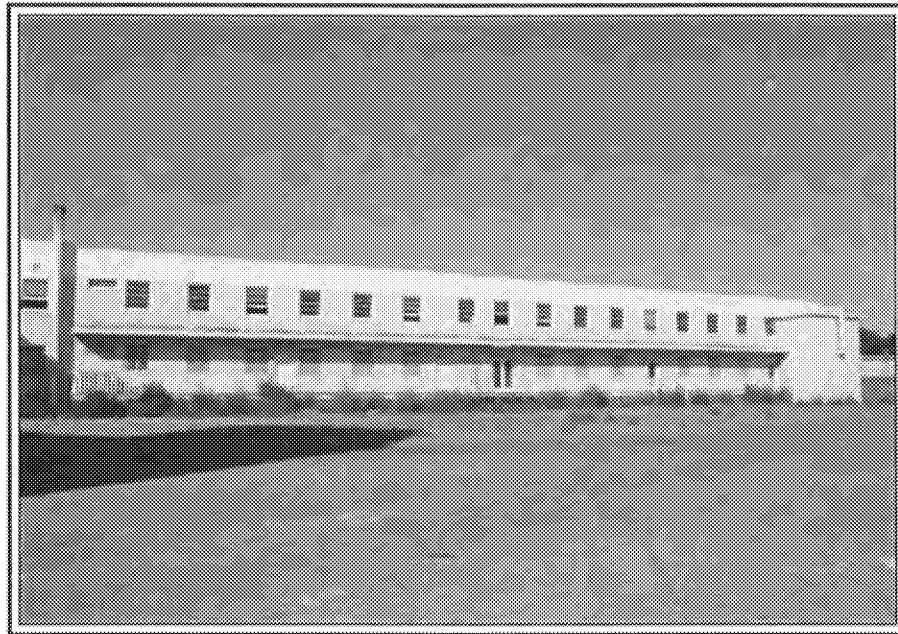
Surface Soil: None
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Low (common drains with Building 253)

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: Low
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: Low (common drains with Building 253)

Recommended Actions: Remediate area of Th-232 contamination. Final Status Survey following remediation.

8.3.3.4 Building 214



Site Description: Building 214 is of typical wooden WW II era administration building design, built from standardized Bureau of Yards and Docks plans (HRA-1118, p 108). A building site plan is provided in Figure 8.3.3.2 above.

Former Uses: Combat Weapons Systems Office (HRA-4667), administrative offices (HRA-2963), Accounting and Bond Office, Triple A office space, and NRDL Health Physics counting room in Room 105 (HRA-3052 End 3).

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Surveys completed.

1996 PRC – survey found no detectable activity in building.

1974 Shipyard closure survey. No detectable activity.

Contamination Potential: Unlikely.

Contaminated Media:

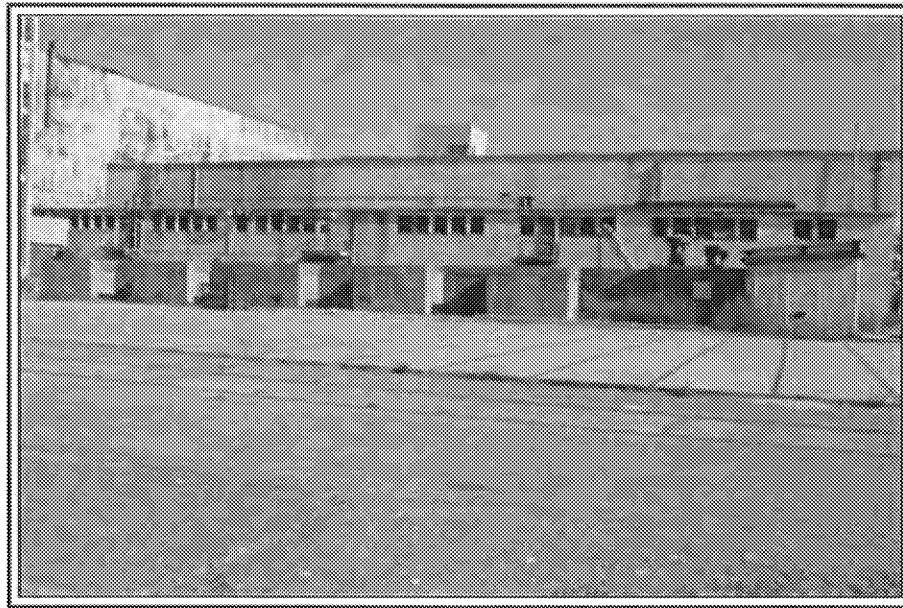
Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.3.5 Building 224



Site Description: Building 224 is a reinforced concrete bomb shelter (in foreground) that was built in the main industrial area of HPS in 1944. The building is mostly underground, rising only 3 feet out of the ground (HRA-1118, p 86). Metal doors and stairwells lead to a series of small rooms. A building site plan is provided in Figure 8.3.3.2 above.

Former Uses: Air raid shelter and OPERATIONS CROSSROADS and GREENHOUSE sample storage (HRA-405; HRA-4667).

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, and Sr-90.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Survey complete. One sample from cell showed Cs-137 levels slightly exceeding the release criteria. The contamination was apparently removed with the sampling, as it cannot be located again. Survey results currently under review.

Contamination Potential: Unlikely.

Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.

8.3.3.6 Building 241



Site Description: Building 241 is a large wood-framed, monitored (lights and ventilation) shop building, including a shallow, almost flat, gabled roof with monitors and shallow shed-roofed forms at either side. A building site plan is provided in Figure 8.3.3.6.

Former Uses: Forge Shop (HRA-2963).

Current Uses: Unoccupied.

Radionuclides of Concern: Naturally occurring thorium from firebrick and known use of potassium nitrate.

Previous Radiological Investigations: 2002 NWT Phase V investigation. Survey completed. Potassium nitrate and firebrick removed and disposed of off site.

Contamination Potential: Unlikely.

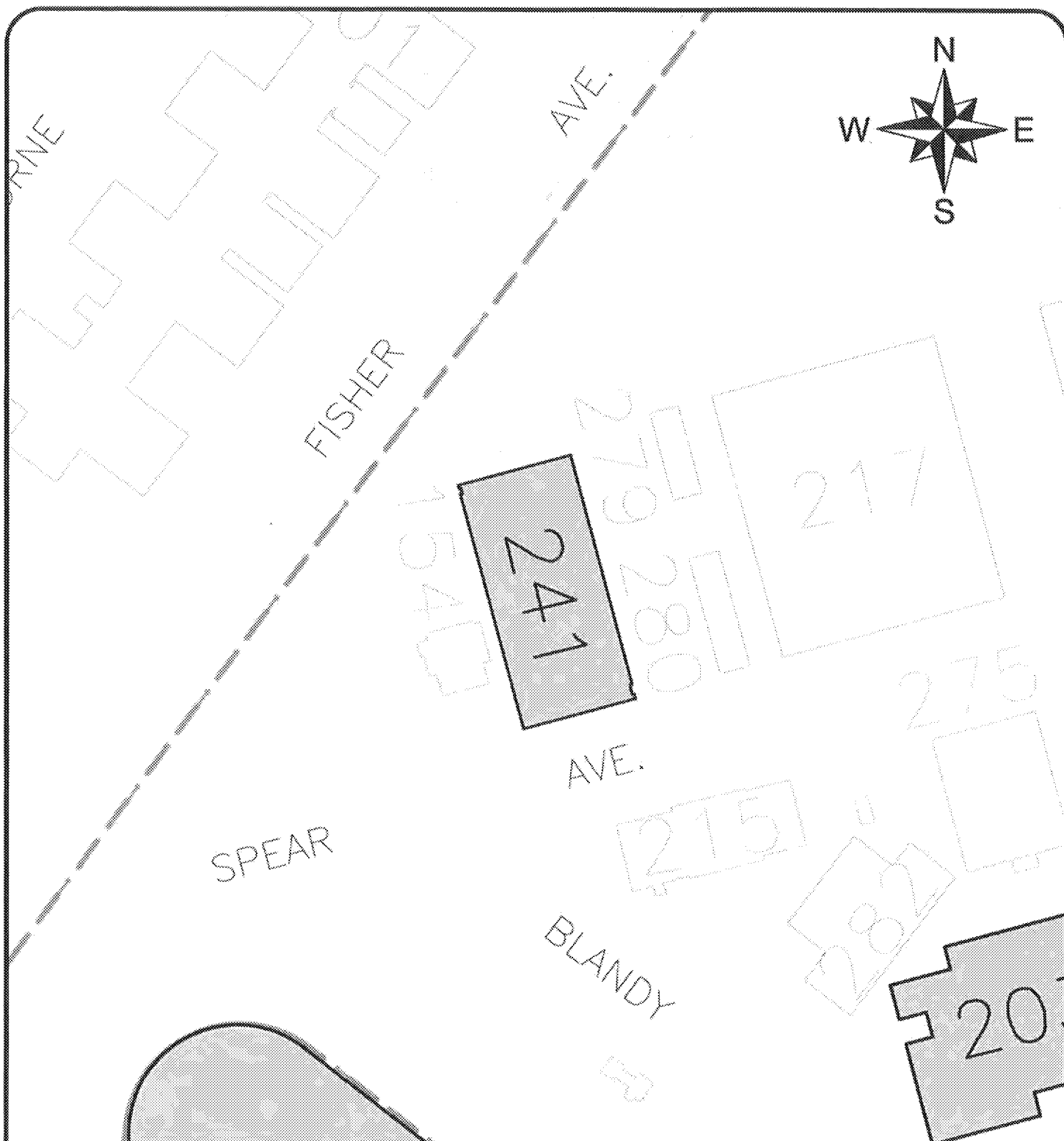
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



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SAGE Consultants, Inc.
SAGE CONSULTANTS, INC. 1978 VENTURE BLVD., CAMARILLO CA 93010-7847
Tel. (805) 453-0060 Fax (805) 389-5815
www.sagecons.com

100 0 100



Scale in Feet

-  Impacted Site with Designation
-  Impacted Site with Designation (Demolished)
-  IR Site w/ Designation
-  Non - Impacted Building
-  Non-Impacted Building (Demolished)
-  Topographic Feature
-  Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 241 Site Plan

January, 2004

Figure 8.3.3.6

8.3.3.7 Building 253



Site Description: Building 253 is a six-story concrete-framed, glass curtain-walled building built between 1944 and 1947. The building has a large gantry for the craning of equipment to the upper stories and a periscope tower extending vertically from the roof. Building 253 is attached to Building 211 (HRA-1118, pp 94-96). The glazing for Building 253 is standard glass. A building site plan is provided in Figure 8.3.3.2 above, and a floor plan (first floor) is provided in Figure 8.3.3.7FP.

Former Uses: Radiography and instrument calibration through 1974 (HRA-601, p 9); Gauge Shop (HRA-601, p 10); Electronics, Optical, and Ordnance Shops (HRA-2963); Weapons Shop (HRA-372, p 14); Electrical Shop (HRA-372, p 17); storage of equipment from OPERATION CROSSROADS ships; Maritime Administration Ship Parts Storage (1994); and probable location of radium paint activities (Gauge Shop).

Current Uses: Unoccupied.

Radionuclides of Concern: Cs-137, Pu-239, Ra-226, Sr-90, and Th-232.

Previous Radiological Investigations:

- 2003 NWT partial building Characterization Survey.
- 2002 NWT Phase V investigation. Extensive low-level contamination (Cs-137 and Ra-226) found in and on the building and in the building ventilation system. Remediation completed on roof.
- 1974 Shipyard closure survey of sixth floor. No detectable activity based on limits for the period.

Contamination Potential: Known-Restricted Access.

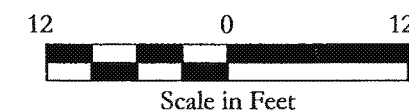
Contaminated Media:

Surface Soil: None
Subsurface Soil: Moderate from drain line leakage
Sediment: High
Surface Water: None
Groundwater: None
Air: None
Structures: High
Drainage Systems: High

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: Low
Sediment: Moderate
Surface Water: None
Groundwater: None
Air: None
Structures: Moderate
Drainage Systems: Moderate

Recommended Actions: Complete Characterization Survey and remediate known areas of contamination. Final Status Survey once remediation is completed.



Notes:

Floorplan recreated from background image Map ID 167.



First Floor Plan

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

May, 2003



New World Technology
448 Commerce Way, Livermore CA 94550
Phone (925) 443-7967 Fax (925) 443-0119

 **SAGE** Consultants, Inc.
1978 Ventura Blvd., CAMARILLO CA 93010-7847
Tel. (805) 482-6088 * Fax (805) 389-9815
www.sagecon.com

Figure 8.3.2.8 FP
Building 146 - Floor Plan

8.3.3.8 Building 271



Site Description: Building 271 is a single-width, metal-sided shop building that was built in 1947 and manufactured by the Butler Company or in the manner of Butler Company buildings. This prefabricated, standard building was used on military bases due to limited budgets (HRA-1118, p 106). A building site plan is provided in Figure 8.3.3.8.

Former Uses: Spray Painting (HRA-171, p 16), Paint Shop Annex (HRA-2963), and Equipment Storage/Barge Services Office (Supervisor of Shipbuilding, Conversion, and Repair [SUPSHIP]) (1994).

Current Uses: Unoccupied.

Radionuclides of Concern: Ra-226.

Previous Radiological Investigations:

2002 NWT Phase V investigation. Low-level Ra-226 contamination found.
Remediation and disposal completed. Resurvey complete.

Contamination Potential: Likely.

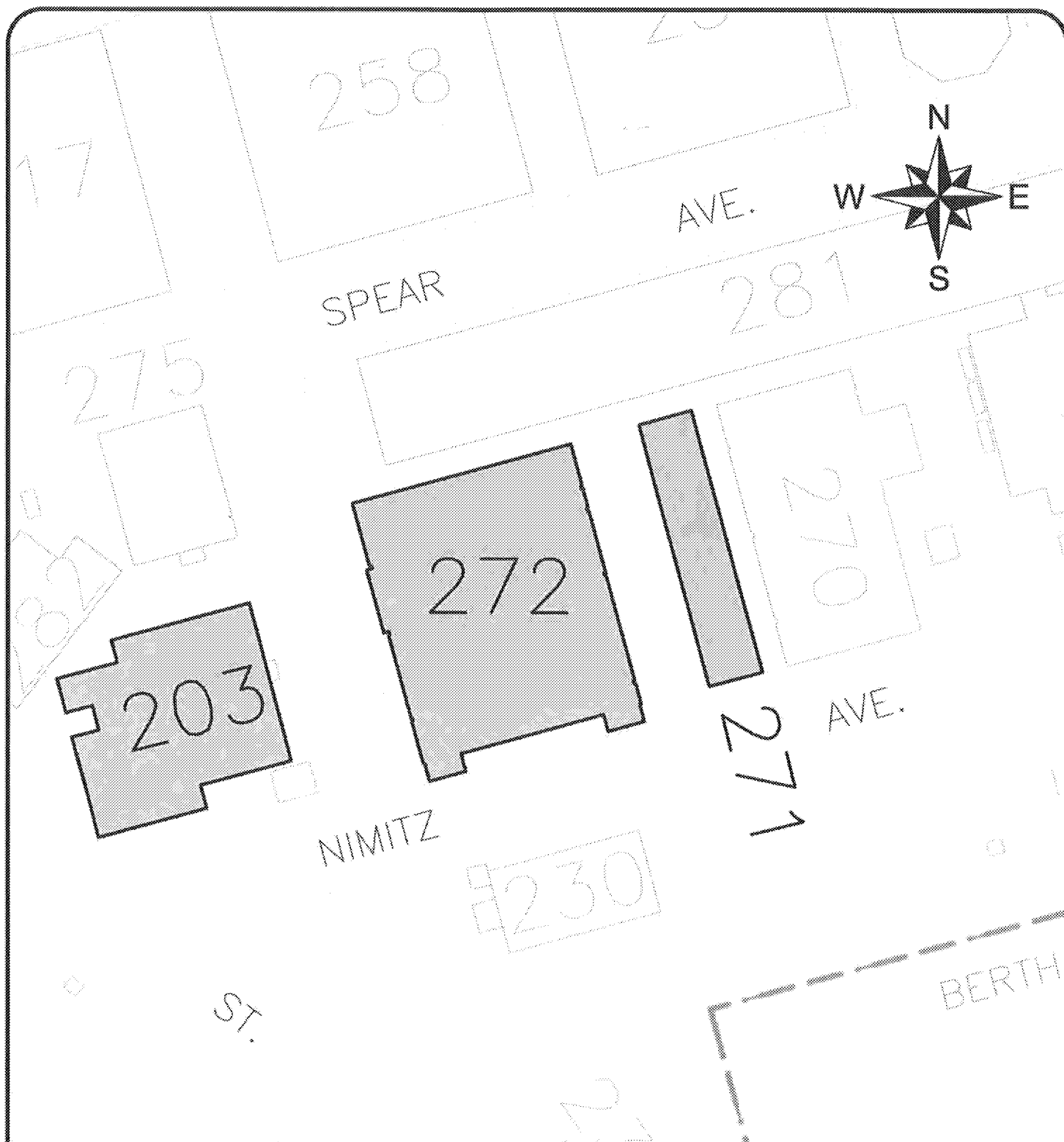
Contaminated Media:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Potential Migration Pathways:

Surface Soil: None
Subsurface Soil: None
Sediment: None
Surface Water: None
Groundwater: None
Air: None
Structures: Low
Drainage Systems: None

Recommended Actions: Review Final Status Survey Report.



New World Technology
448 Commerce Way, Livermore CA 94550
Phone (925) 443-7987 Fax (925) 443-0119



SAGE Consultants, Inc.

SAGE CONSULTANTS, INC. IS AN EQUAL OPPORTUNITY EMPLOYER
1978 Vestaire Drive, CA 94501-1000
Tel. (925) 482-6088 * Fax (925) 349-0815
www.sagecon.com








100

0

100



Scale in Feet

-  Impacted Site with Designation
-  Impacted Site with Designation (Demolished)
-  IR Site w/ Designation
-  Non - Impacted Building
-  Non-Impacted Building (Demolished)
-  Topographic Feature
-  Parcel Boundary

Hunters Point Naval Shipyard
San Francisco CA
Historical Radiological
Assessment

Bldg. 271 & 272 Site Plan

January, 2004

Figure 8.3.3.8